Packet Network Tester and Analyzer MAKS-EMK

User Manual Combined with Data Sheet

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The present MAKS–EMK User Manual is meant to make the user familiar with the Tester/Analyzer characteristics and service instructions to operate it correctly and effectively.

In the present Manual, the following abbreviations and designations are used:

Table 1.1

ARP	Address Resolution Protocol
AVAIL	Channel Availability
Back-to-back	Limit Load test
BER	Bit Error Rate
CBS	Committed Burst Size, guaranteed load. This parameter indicates maximum quantity of transmitted test traffic bytes CIR conditions being fulfilled
CIR	Committed Information Rate. This parameter defines average test traffic rate in bps, up to which CoS conditions are fulfilled
CoS	Class of Service
CRC	Cyclic Redundancy Checksum
DDM	Digital Diagnostics Monitoring
DF	Delay Factor
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DSCP	Differentiated Services Code Point
DUT	Device Under Test
EBS	Excess Burst Size
EIR	Excess Information Rate, maximum admissible exceeding of CIR. The parameter defines average test traffic rate in bps up to which CoS conditions are fulfilled
FDV	Frame Delay Variation, packet jitter
FLR	Frame Loss Ratio
Frame Loss Rate	Frame Loss Rate test
FTD	Frame Transfer Delay
GPS	Global Positioning System
IFG	Inter Frame Gap
IP	Internet Protocol
IP address	Unique identifier (address) of a device connected to the integrated network on TCP/IP basis
LAN	Local Area Network
Latency	Frame latency test
MAC	Media Access Control
MAC address	Unique identifier (address) used for network devices addressing at the physical layer
MDI	Media Delivery Index

MLR	Media Loss Rate
OAM	Operations Administration Maintenance (Channel status monitoring protocol)
OSI	Open Systems Interconnection Reference Model
QoS	Quality of Service settings
PCP	Priority Code Point (for VLAN as per IEEE 802.1p)
PDV	Packet Delay Variation
Ping	Utility used for connection test in TCP/IP-based networks
Policy	The test showing traffic spikes. Spikes occur at a speed exceeding CIR+EIR value
Precedence	Traffic Precedence
PTP	Precision Time Protocol
RJ45	One of Registered Jack standard connectors used for connection of twisted pairs
SFD	Start of Frame Delimiter
SFP	Small Form-factor Pluggable (A transmitter/receiver used for data transmission in telecommunications)
SLA	Service Level Agreement (An agreement on the service level between an operator rendering communication services and a client)
Throughput	Throughput test
ToS	Type of Service
TPID	Tag Protocol Identifier
VID	VLAN Identifier
VLAN	Virtual Local Area Network
VLAN tag	The corresponding field of Ethernet frame
VLAN ID	VLAN Identifier
TP	Twisted Pair
SC	Short Circuit
PC	Personal Computer
SW	Software

Conventions

Conventions listed in the table below are used in the present User Manual.

Table 1.2

Description	Example
Text **in bold** shows user's action	press **"Save"** button
Names of menu items and input & display fields are represented **in bold**	on the **"Statistics"** menu
Text to be entered into menu fields or the PC is displayed in the following font	in the following way: http://192.168.0.111
Paragraphs marked with "**Caution**!" warn the user against a hazardous situation that may damage the equipment or cause bodily injuries.	**Caution!**

1 Purpose

Packet Network Tester and Analyzer MAKS-EMK is destined for use while servicing, commissioning and certifying Ethernet and Gigabit Ethernet networks.

MAKS-EMK performs accurate measurements of copper Ethernet (10BASE-T, 100BASE-T, 1000BASE-T) and optical Ethernet (1000BASE-X).

MAKS-EMK functional capabilities include:

- Traffic generation and testing at data link, networking and transport Layers at two interfaces simultaneously
- RFC 2544-recommended test procedure
- Y.1564-recommended test procedure
- Packet jitter measurement
- Loopback testing at physical, data link and networking Layers
- Testing of channel integrity and IP routes
- Received and transmitted traffic statistics collection and display
- Connection between measuring ports (Through mode)
- Copper cable diagnostics
- Remote control via USB port and Ethernet

1.1. Utmost Permissible Operation Conditions

MAKS-EMK is a portable Tester designed for operation within the following conditions:

- environment temperature + 5 °C… + 40 °C
- relative air humidity up to 90% at the temperature of + 25 °C
- atmospheric pressure 450 Mmhg (60 kPa) min. and 795 Mmhg (106 kPa) max.

The Tester is powered from a built-in battery (1 ea, LiIon type) or AC mains 220-230 V 50-60 Hz (if a power unit is used). MAKS-EMK is meant for continuous 24 hours operation.

2 Technical Information and Specifications

The Tester provides:

- support and testing of two fully independent Ethernet/Gigabit Ethernet interfaces
- traffic generation at physical, data link and networking Layers
- received and transmitted traffic statistics collection and display (sorting according to frame types, sizes and erroneous frames)
- current test results generation and on-screen display
- RFC 2544-recommended measurements of throughput, latency, frame loss and back-to-back
- Y.1564-recommended measurements of configuration and performance
- channel integrity and IP routes testing: ping, traceroute, DNS support, IP scanner
- loopback at physical, data link, networking and transport layers, with or without MAC and IP swapping
- pass-through connection from one measurement port to another with monitoring and statistics collection (Through mode)
- incoming traffic filtering at data link and networking layers
- cable diagnostics
- ARP & DHCP support
- remote device detection via Ethernet OAM
- RFC 4445-recommended testing of MDI metrics
- optical test including input and output power measurement
- symmetric and asymmetric channel traffic transmission test
- testing in Multistream mode
- packet jitter measurement
- measurement of clock conditions according to PTP IEEE1588
- remote control via USB port and separate Ethernet port by means of remote management software
- independent storage of test/interface settings and test results in the internal memory of the Tester

Specifications

Table 2.1

Characteristics	Description
Interfaces	
Electrical Ethernet/IP	Two RJ45 interfaces 10 Mbps, 100 Mbps,1000 Mbps
Optical Ethernet/IP	Two SFP interfaces 1000 Mbps
Managing interface for connection to PC	USB client, Ethernet 10/100 BASE-T
Display	Graphical, multicolour, 320x240 dpi
Battery	Li-Ion, 1 ea
Weight and Size	
Depth	225 mm
Width	110 mm
Height	53 mm
Weight	0.67 kg
Power	
Stand-alone operation in test mode	up to 9 h
Battery charge time	2 h max.
Supply voltage	12 V
Utmost Permissible Operation Conditions	
Environment temperature	+ 5 °C… + 40 °C
Relative air humidity	up to 90% at the temperature of + 25°C
Atmospheric pressure	450 Mmhg (60 kPa) min. and 795 Mmhg (106 kPa) max.
Other Characteristics	
TST test output pulse amplitude	1.5 V ± 0.5 V

3 Scope of Supply

Table 3.1

Name	Quantity	Note
MAKS-EMK Tester and Analyzer	1	
Power unit	1	*
USB cable	1	*
Duplex patch cord	3	*
Duplex optical patch cord	2	**
K-08 cable for checking and reference signals	2	**
Fiber optic SFP module	2	**
Carrier bag	1	*
Software CD	1	
User Manual combined with Data Sheet	1	
* It is possible to use items of other types providing the same characteristics of the Tester		
** Supplied at customer’s request		

4 Tester Structure and Operation

4.1. Front Panel

Figure 4.1 shows front panel of the Tester where LED indicators, display and keypad are located.

Figure 4.1 Front Panel

4.1.1. LED Indicators

LED indicators (LEDs) provide visual control of measuring conditions and data transmission/reception.

LEDs are placed directly above the display. Both A and B ports are provided with four LEDs each: Test, Rx, Tx, Link (left to right). Depending on Tester operation modes, LEDs show different types of status information. On the display under LEDs you can find captions describing mode of the Tester and the LEDs.

LED Description

Test LEDs show port engagement in test fulfillment. At that, they can be of three different colours:

- **green** – either **“Loopback”** or **“Through”** mode is on, or the port is engaged in test fulfillment;
- **orange** – one of unfinished tests containing errors is being fulfilled at the moment;
- **red** – the last test on the port was unsuccessful;

On-screen captions of **Test** LEDs can be as follows:

A->A – traffic transmission topology from Port A to Port A selected;

A->B – traffic transmission topology from Port A to Port B selected;

A->R – for asymmetric test mode - traffic transmission topology from Port A to a remote point, or from a remote point to Port A selected;

B->A – traffic transmission topology from Port B to Port A selected;

B->B – traffic transmission topology from Port B to Port B selected;

B->R – for asymmetric test mode - traffic transmission topology from Port B to a remote point, or from a remote point to Port B selected;

BERT – port is busy with **“BER”** test traffic reception/transmission;

CAB – port is busy with cable test signals reception/transmission;

DNS – port is busy with **“DNS”** test packets reception/transmission;

JIT – port is busy with **“Packet Jitter”** test traffic reception/transmission;

LB – **“Loopback”** menu option has been selected;

LB1 – Layer 1 **“Loopback”** mode is on;

LB2 – Layer 2 **“Loopback”** mode is on;

LB3 – Layer 3 **“Loopback”** mode is on;

LB4 – Layer 4 **“Loopback”** mode is on;

MDI – port is busy with MDI test traffic transmission;

MS – port is busy with **“Multistream”** test traffic transmission and reception

OAM – **OAM** mode is activated;

PING – port is busy with **“Ping”** test traffic reception/transmission;

RFC – port is busy with **“RFC 2544”** test traffic reception/transmission;

SCAN – port is busy with **“IP Scanner”** test traffic reception/transmission.

THRU – **“Through”** menu has been selected or **“Through”** mode is on;

TRR – port is busy with **“Traceroute”** test packets reception/transmission;

TRAF – port is busy with test traffic data reception/transmission.

PTP – port is busy with **“PTP”** test data reception or transmission.

Y1564 – port is busy with **“Y.1564”** test traffic reception/transmission.

Test LED caption is highlighted white in **“Loopback”** and **“Through”** modes. **Test** LED caption is highlighted yellow on **“Process Topology”** menu at traffic generation port and also during tests with traffic generation. **Test** LED

caption is highlighted red if the last test performed at that port was not successful.

Rx LEDs report data reception status:
green – frames are being received at the corresponding port.
Green highlighting of **Rx** LED caption reports the port being test traffic recipient, or **“Loopback”** or **“Through”** modes being on.

Tx LEDs report data transmission:
green – frames are being transmitted at the corresponding port.
Yellow highlighting of **Tx** LED caption reports the port being test traffic transmitter, or “**Loopback”** or **“Through”** modes being on at that port.

Link LEDs report **connection** status:
Green – the corresponding port is connected
On-screen captions of the LEDs report transmission speed: **1000** for 1000BASE-T and 1000BASE-X, **100** for 100BASE-T, **10** for 10BASE-T, **NS** – no synchronization. **“H”** symbol stands for half duplex mode and **“F”** symbol stands for full duplex mode.

4.1.2. Display

Tester screen is represented by a coloured graphical LCD with 320×240 pixels resolution.

4.1.3. Keypad

The Tester is managed and alphanumeric information is entered by means of the keypad.

Keys

– **“On/Off” key** (see Paragraph 9.5).

– functional keys whose functions depend on Tester mode. If the key is available, its dedication will be displayed in the keys description in the lower part of the display.

– arrow keys.

– **“Enter”** key. It is used to enter the menu sections or subsections and to change menu options.

– **“Menu”** key, press it to return to the previous menu or cancel current action.

– keys for alphanumeric symbols and characters entry.

4.1.4. External Connectors

Figure 4.1.4 shows location of external connectors on the upper, lower and lateral sides.

All connectors are marked on the housing of the Tester in accordance with the denominations listed in Table 4.1.

Table 4.1. Purpose of MAKS-EMK Connectors

Marking	Purpose
A, B	RJ-45 to connect to DUT or network under test
SFP A, SFP B	to connect to DUT or network via SFP modules
	reference signal input connector
	checking signal output connector
	a USB port for remote management
	an RJ11 for connection of a headset
	an RJ45 for remote management
	for power unit connection and battery charging
	hidden hardware reset button *
	charging indicator LED
	grounding connector

* **Note**: To reset of the Tester, press the hidden reset button with a thin blunt pin. At that, current settings are not saved, and next time the Tester is switched on its settings will go back to the data saved when the Tester was switched off normally last time (see Paragraph 9.5).

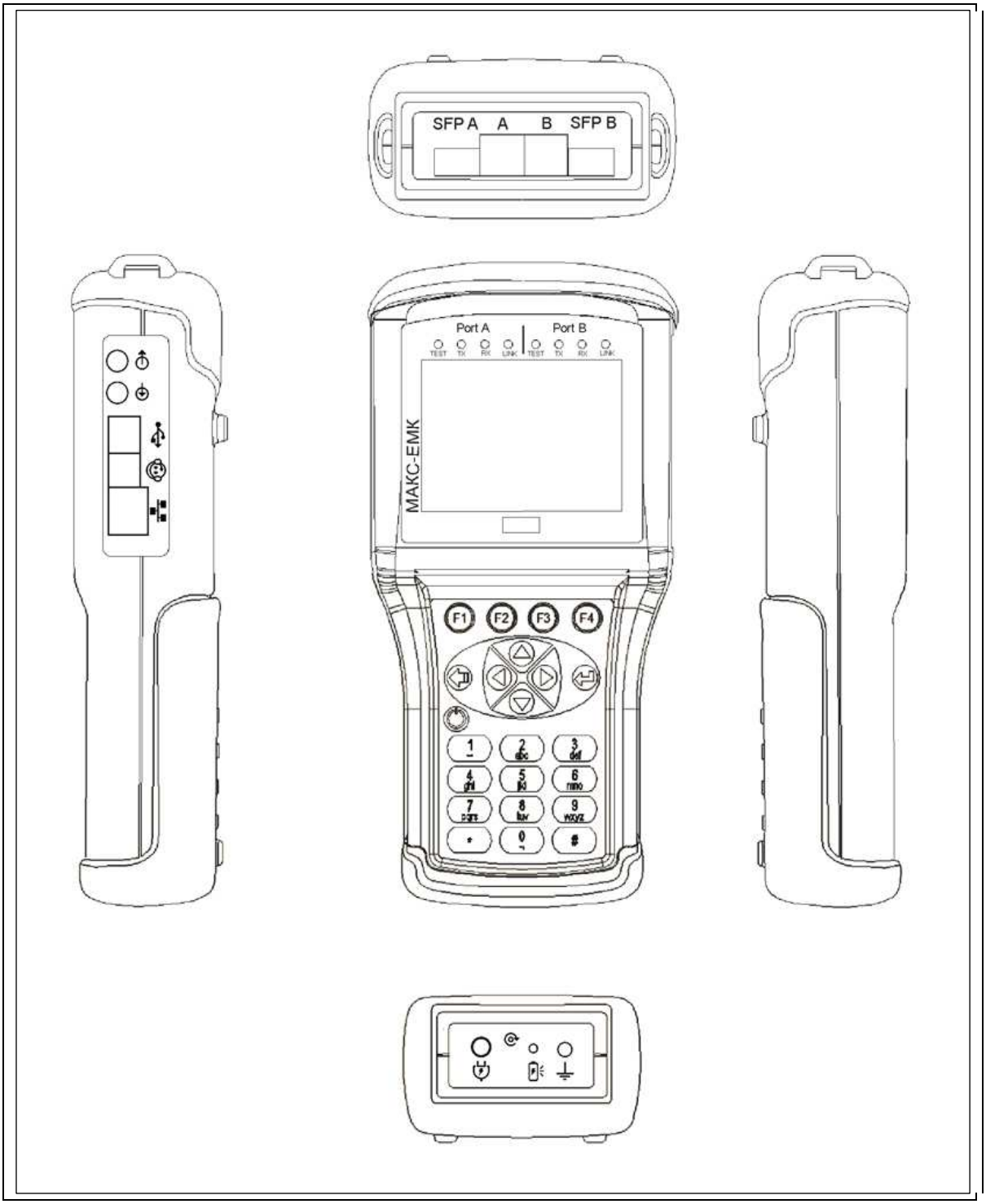

Figure 4.1.4 Location of Connectors

Connection of SFP Receiver/Transmitter

SFP A and SFP B connectors are used for connection of SFP optical modules or SFP copper modules with external RJ45 to the Tester. SFP modules supplied with the Tester and other modules can be used.

Please make sure that the receiver/transmitter and the connector support the same physical interfaces before inserting the SFP module. Do not forget to lock the SFP module latch. When inserting the SFP module make sure that its label is facing the Tester front panel. When the module is installed it will be securely fixed in the connector using the module's locking latch. If the module has been installed properly, you will hear a click.

Caution! If it is not easy to install the SFP module for the first time, please do not exert extra force on it to avoid connector damage.

Before an SFP module (see Paragraph 10.21.6) is securely fixed, the corresponding LED may already indicate its availability. Please make sure that the module has been installed correctly.

Please use a rubber cap to protect a temporarily unused SFP module from contamination.

Before removing an SFP module from the connector, disconnect fiber optical plugs by pressing their latches and carefully take the cable out of the receiver/transmitter. After that, unlock the SFP module latch and pull it to remove the module from the connector.

Correct storage of SFP modules: you should use antistatic boxes or packages and protect fiber optical connectors with rubber caps.

4.2. Component Specifications

4.2.1. Power Unit

MAKS-EMK power unit serves to supply the Tester from AC mains and integral battery cell. It represents a static power supply unit with built-in short circuit and overload protection.

Input: AC voltage 100 ÷ 240 V, 50 ÷ 60 Hz.

Output: DC voltage 12 V, current up to 1.5 A, constant.

Power unit soldered connections are arranged according to Figure 4.2.

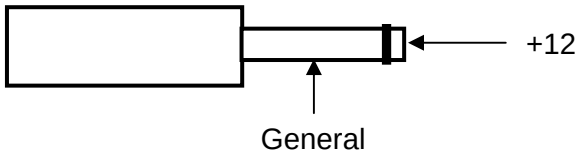

Figure 4.2 Soldered connections of power unit jack plug

5 Marking

5.1. MAKS-EMK Tester has the following marks:
- name of the manufacturer;
- equipment conditional name;
- month and year of manufacture;
- equipment serial number (as per manufacturer's numbering system).

5.2. Marking of consumer packaging includes:
- trademark of manufacturing plant;
- name and plant denomination of the device;
- packing date;
- transportation and storage temperature information.

5.3. Shipping data must include:
- consigner and consignee names;
- cargo package gross and net weight;
- "Fragile freight!", "Keep dry" and "This side up!" handling instructions.

6 Packaging

6.1. MAKS-EMK Tester, its accessories kit and in-line documentation are placed into a bag and then packed into a cardboard box according to the corresponding construction documentation. Packing the Tester into an additional box is specified in the delivery contract. Pack the equipment in a room with relative humidity of 80 % max. and at a temperature of 15°C… 35°C.

7 General Operation

7.1. Before starting MAKS-EMK operation it is highly recommended to familiarize with the present User Manual, purpose of keys, external connectors and components of the Tester.

7.2. The Tester should be operated in the conditions not exceeding its operation conditions. The supply mains must be free from voltage spikes. There must not be strong electrical and/or magnetic field sources next to the working place.

7.3. Protect the Tester and its power unit from hits, moisture, dust and continuous exposure to direct sunlight.

7.4. If you put the Tester into operation after its stay in cold weather conditions, you will have to place it in standard environment for at least 2 hours, and only then start its operation.

7.5. If service interruptions last for more than two hours, it will be recommended to disconnect power unit from the mains.

7.6. The Tester can be powered from:

- mains 220-230 V, 50-60 Hz by means of a power unit;
- battery cells (LiIon, 1ea).

To charge the battery, connect MAKS-EMK tester to the mains via its power unit. At that, the Tester can be either switched on or switched off.

" " indicator in screen bottom-right corner shows battery characteristic. The fewer segments are displayed, the lower battery is. At that, as battery discharges, indicator colour starts changing into green, yellow and red. When battery is being recharged, the indicator alternately changes its colours. As soon as power supply is connected, battery indicator will acquire the following form: " ".

Battery cell characteristic (refer to paragraph **10.22.4).** Full battery charge time in normal weather conditions does not exceed 2 hours.

Battery service life depends on the amount of "charge-discharge" cycles. This battery type is meant for approximately 500 "charge-discharge" cycles.

When battery cells are fully charged, and depending on their condition, Tester operating period in off-line mode will be equal to at least 9 hours.

When battery is discharged, the Tester will emit audio signal every 30 seconds. The Tester turns off automatically when battery is much discharged. At that, it is possible to turn it on but the Tester will turn off automatically in 5 seconds. To prevent full discharging of Tester battery and configuration reset, do not keep the Tester discharged for a period of time exceeding 2 days.

8 Safety Precautions

Caution! External power unit carries fatal voltage. Do not operate the power unit if damaged.

9 Preparation for Work

9.1. Unpack the Tester and examine it visually. Check set completeness according to Table 2.1.

9.2. Keep the Tester in normal conditions for at least 2 hours.

9.3. Plug in the power unit (if Tester is going to be mains-powered).

If Tester is going to be battery-powered, you will have to charge the battery cells

9.4. To switch the tester on, press **On/Off** key and hold it for 2 seconds. When the tester is powered, a welcome message will appear on the screen.

To switch the Tester off, press **On/Off** key once and confirm the action using the menu. The tester saves its current settings each time it is switched off correctly. Each time the tester is switched on it will download saved settings and turn on the configured functions.

10 Operation Procedure

10.1 Working with Menus and Entry Fields

Main menu appears as soon as you switch Tester on Figure 10.1 shows main menu structure.

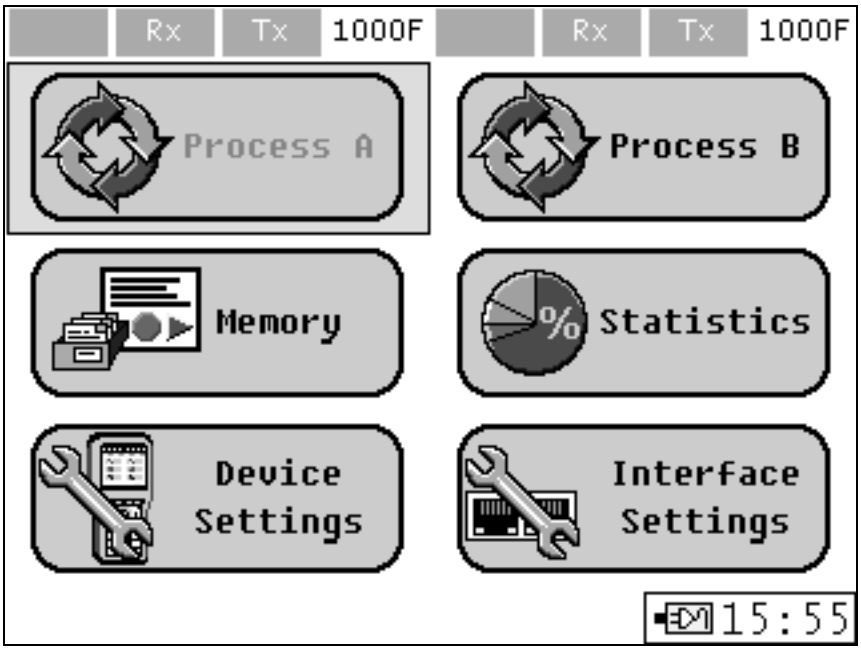

Figure 10.1 Main menu

“Process A” and **“Process B”** menus are designed for selection of Port A and Port B that will be involved in testing.

“Memory” menu is designed for saving test and interface settings as well as for viewing the info on the saved settings and measurements.

“Statistics” menu displays statistics;

“Device Settings” menu serves to select the required operation settings;

“Interface Settings” menu displays settings of the following three Ethernet ports: measurement port A, measurement port B and remote management port.

Working with the Menu

Navigation through menu icons, tabs and lines is effected using arrow keys. At that, active icon or tab captions are highlighted blue whereas captions of inactive ones are highlighted black. **“Enter”** key serves to enter menu options. When you enter a tab, your current tab caption will change its colour from black to light grey. To leave your current tab, press **“Menu”** key. Entry fields with changeable parameters and check box captions are blue whereas other information fields are black.

Working with Numeric Entry Fields

Numeric entry fields can be of three types: decimal, hexadecimal and fractional.

Decimal field allows entering integer numbers only. Transition to the following digit of the field is performed automatically after the value of the current digit is entered. To move the cursor within the field, use **“Left”** and **“Right”** keys.

Hexadecimal field allows entering digits and capital Latin letters from A to F. To move the cursor within the field, use **“Left”** and **“Right”** keys.

Fractional field is characterized by a dot delimiter between the integer and fractional parts. It can be entered instead of any digit of the current field by means of holding **“0”** key. To change the position of the delimiter, enter a digit into its place and then enter a dot where necessary.

10.2 “Measurement” Menu

“Process A” and **“Process B”** sections of Main Menu provide access to **“Measurement”** menu designed to select tests for ports A and B.

“Measurements” menu consists of two pages. To go from one page to another, use functional keys **Page 1 / Page 2.**

“Measurements” menu is illustrated in Figures 10.2.1 and 10.2.2.

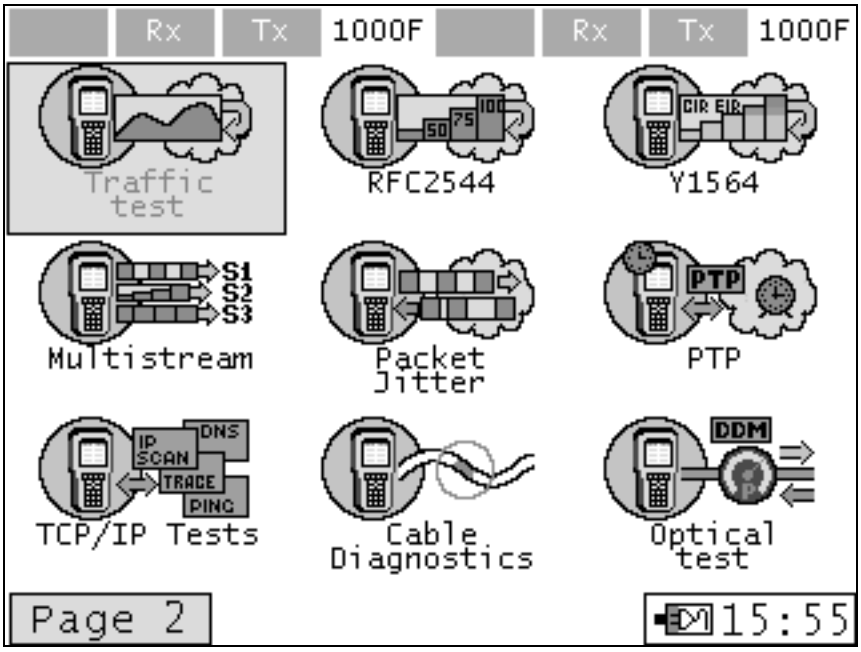

Figure 10.2.1 “Measurement” menu, page 1

The first page of menu includes the following tests:

- **Traffic Test;**
- **RFC 2544 Test;**

- **Y.1564 Test;**
- **Multistream;**
- **Packet Jitter;**
- **PTP;**
- **TCP/IP Tests;**
- **Copper cable Diagnostics,**
- **Optical Test.**

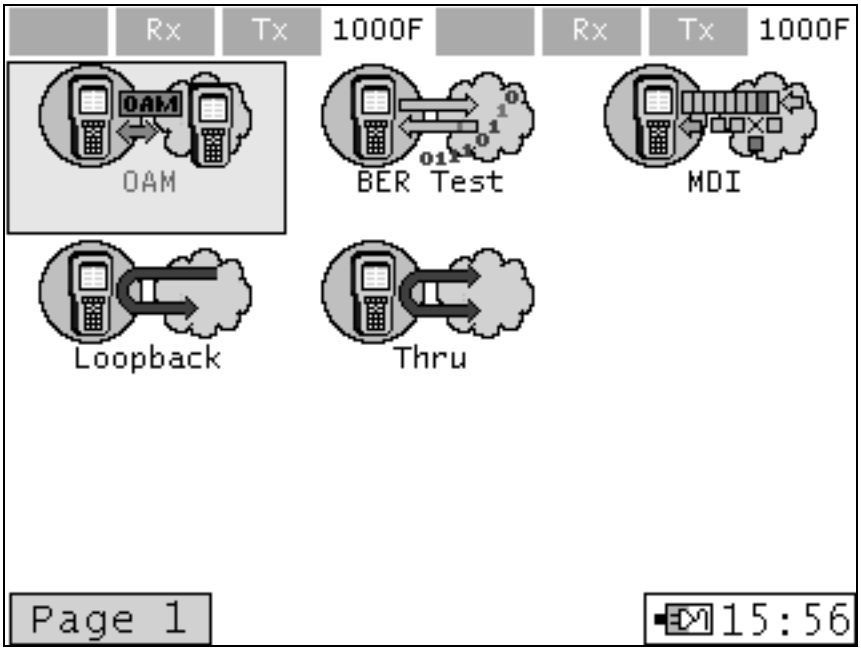

Figure 10.2.2 “Measurement” menu, page 2

The first page of menu includes the following tests:
- **OAM**;
- **BER test**;
- **MDI test**;
- **Loopback mode**;
- **Thru mode**.

Coloured icons indicate launchable tests. Grey icons indicate unavailable (blocked) tests. Test blocking may be caused by conjoint measurements of the selected or another port, or unavailability of the corresponding Tester option.

10.3 Process Topology

“Measurements” menu sections related to tests with traffic generation and reception allow access to “**Topology”** menu. Topology can be selected for tests with traffic generation:

- **Traffic test**;

- **RFC 2544**;
- **Y.1564**;
- **Multistream**;
- **Packet jitter**;
- **BERT**;
- **MDI**.

“Topology” menu is illustrated in Figure 10.3.

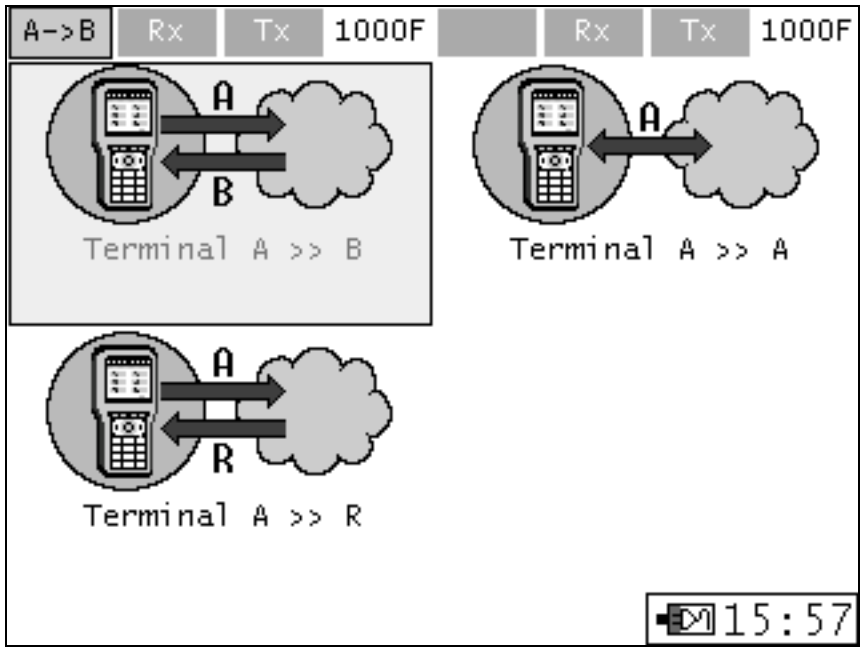

Figure 10.3 “Topology” menu

“Terminal A>>B” – traffic is generated at Port A and received at Port B.

“Terminal A>>A” – traffic is generated and received at Port A, at that traffic is looped at the remote point using “Loopback” function.

“Terminal B>>A” – traffic is generated at Port B and received at Port A.

“Terminal B>>B” – traffic is generated and received at Port B, at that traffic is looped at the remote point using “Loopback” function.

“Terminal A>>R” – traffic is generated at Port A and received at the remote point or it is generated at the remote point and received at Port A, or the process goes bidirectionally.

“Terminal B>>R” – traffic is generated at Port B and received at the remote point or it is generated at the remote point and received at Port B, or the process goes bidirectionally.

The last two modes of the topology are used for testing of asymmetric transmission channels. This topology is available for “Traffic Test” including “08-AT” option only.

When tests are running or “Loopback”/“Thru” modes are activated, the selected port will be busy and access to certain menu items will be blocked for

the avoidance of collisions. At that, the blocked menu items will be represented by grey icons. When tests or modes involving both ports are active, certain menu items of the opposite port will also be blocked.

10.4 Connection Variants

Tests with traffic generation are the following: **“Traffic Test”**, **“RFC 2544”**, **“Y.1564”, “Packet Jitter”**, **“BERT”**, **“Multistream”, “MDI”**.

In order to perform these tests, the Tester is to be connected either to network section or DUT according to the three connection diagrams (A, B and C) illustrated in Figures 10.4.1, 10.4.2 and 10.4.3.

Variant A: loopback function may be activated by means of the second port of the same MAKS-EMK Tester (if two interfaces are available at one point), or MAKS-EM tester, or MAKS-EMB/MAKS-EMBK tools.

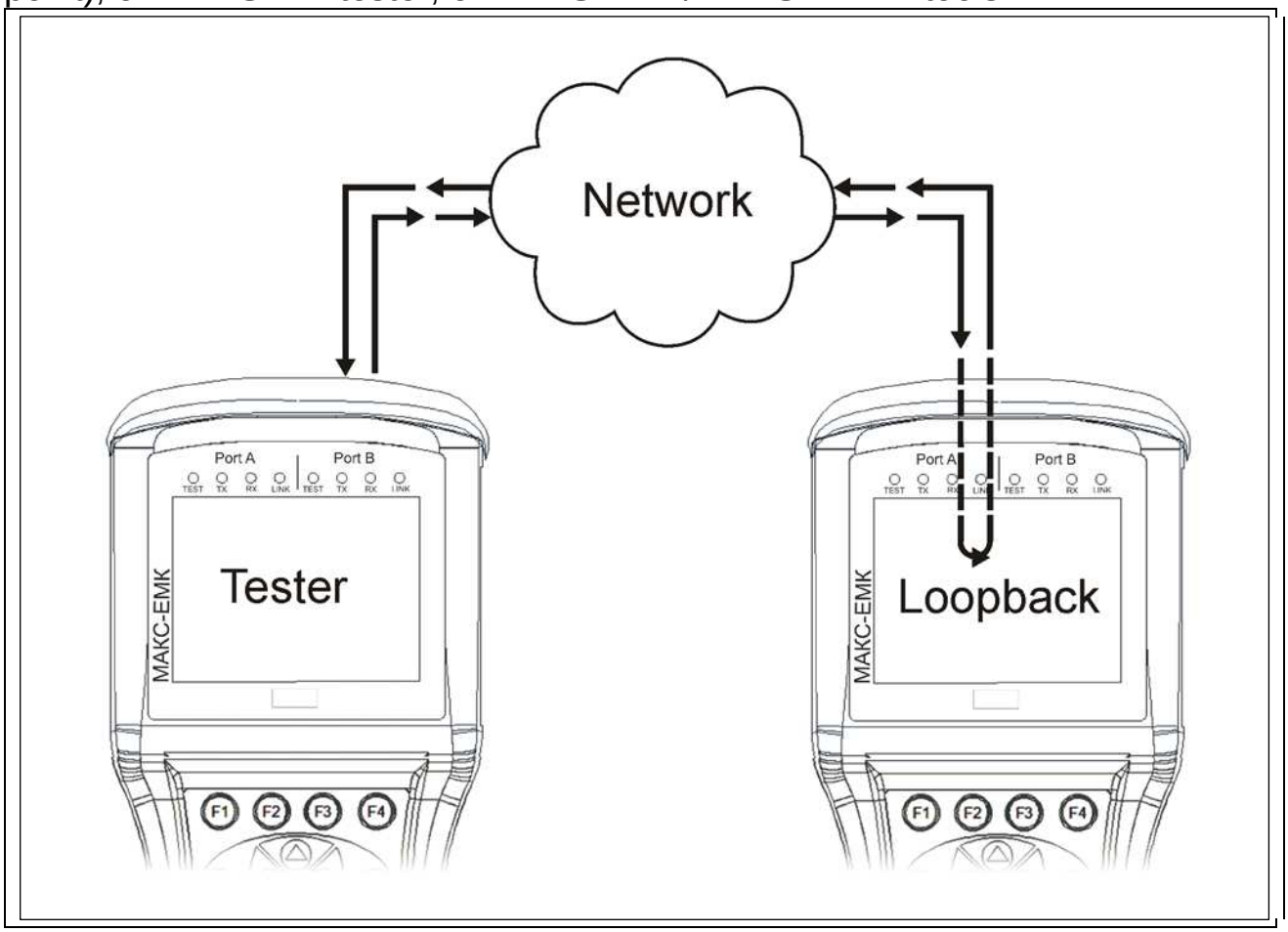

Figure 10.4.1 Tester Connection in the Mode of Symmetric Channels Testing, Variant A

Variant A is suitable for symmetric channels testing. Network sections with distant loopback point are usually tested in accordance with diagram A. At that, loopback Layer (from 1 to 3) is selected depending on the network equipment

used within this network section. For example, if a network section involves only network commutators (switches), you will have to activate Layer 2 Loopback function, but if a section involves routers, you will have to switch on Layer 3 Loopback function. For more on Loopback function, see paragraph 10.17.

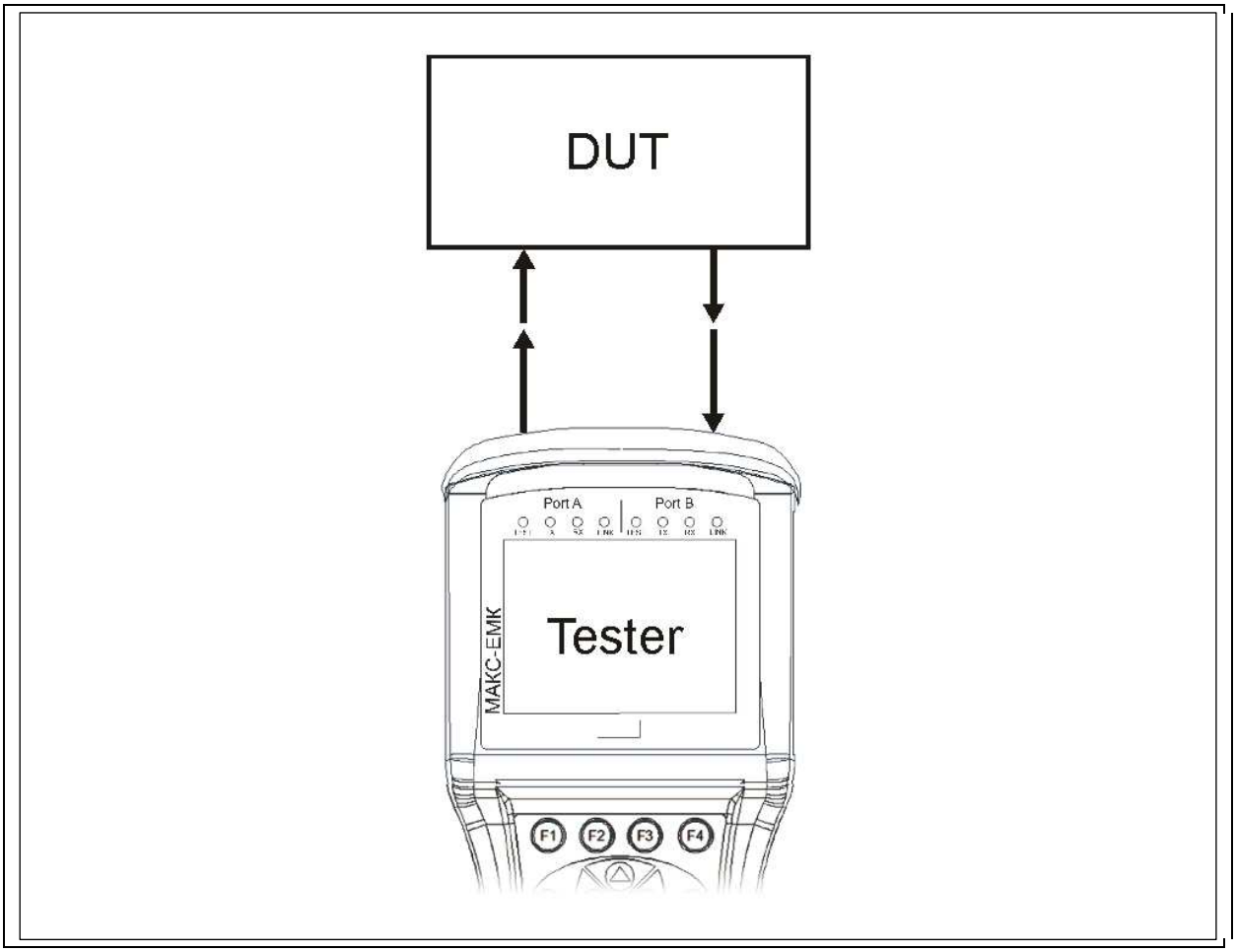

Figure 10.4.2 Tester Connection in the Mode of Unidirectional Testing, Variant B

Variant B is more frequently used for testing of network equipment. In this case test traffic is transmitted in unidirectional way from one port to another.

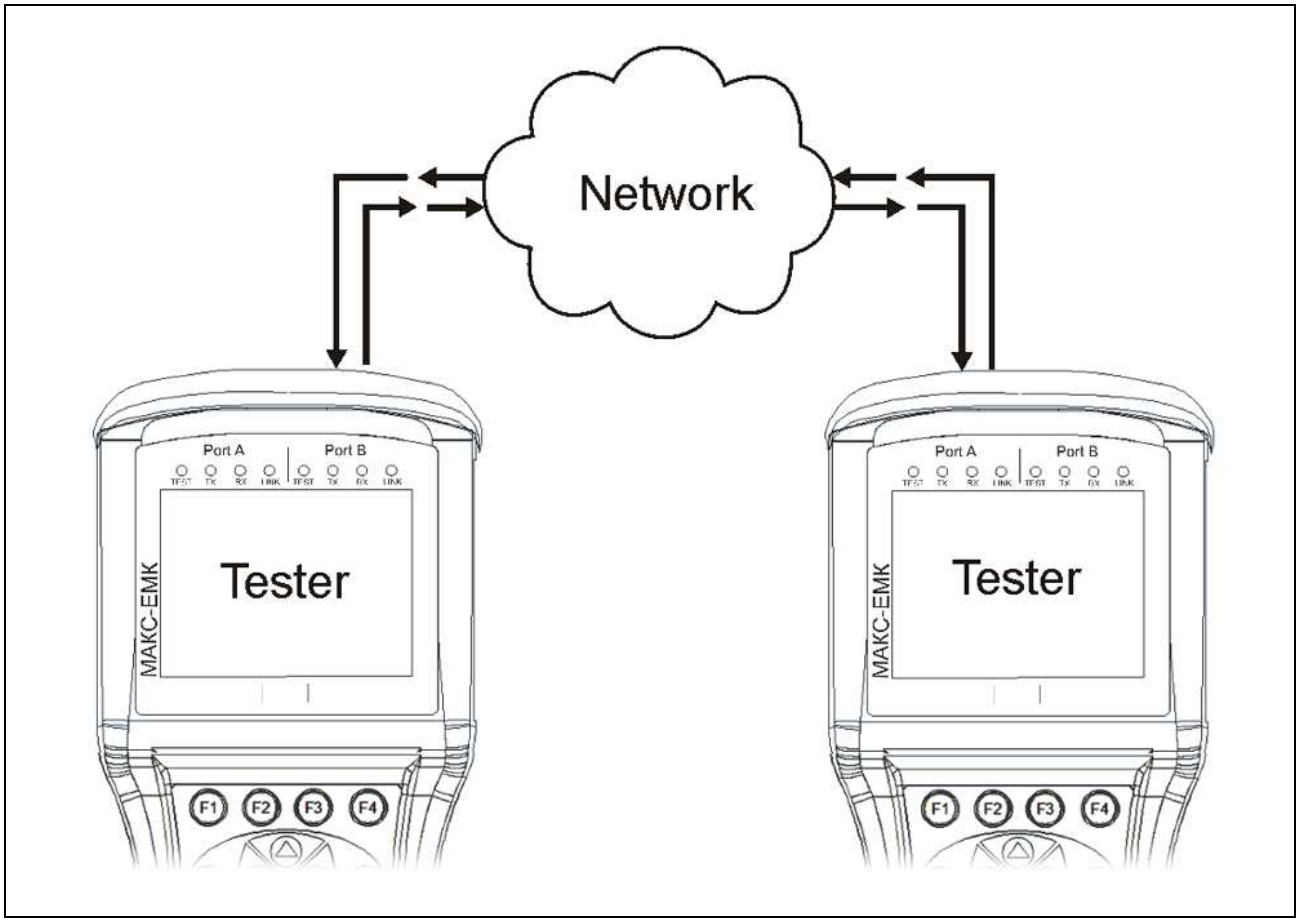

Figure 10.4.3 Tester Connection in the Mode of Asymmetric Channels Testing, Variant C

Variant C is suitable for asymmetric channels testing, when incoming and outcoming streams' parameters differ. Variant C is used for "**Traffic Test"** only.

10.5 Traffic Test

Traffic test is the simplest of all MAKS-EMK tests. It is used for testing of channel transmitting capability.

Traffic is generated and frame loss, latency and packet jitter are analyzed within the set time according to the selected load and frame size.

Traffic test can be used for testing both symmetric and asymmetric channels.

10.5.1 Traffic Test for Symmetric Channels

The Tester is connected according to Variants A or B described in Paragraph 10.4. In this case, one of "Terminal A>>B", "Terminal A>>A", "Terminal B>>A" or "Terminal B>>B" modes is to be selected from "Topology" menu.

“Traffic Test” menu is illustrated in Figure 10.5.1

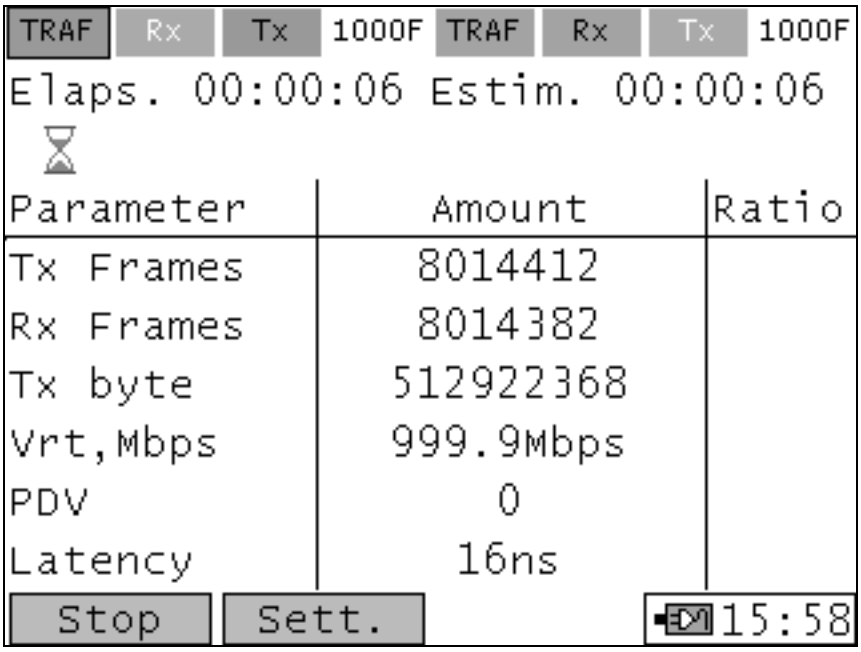

Figure 10.5.1 Traffic test

Test menu contains the following functional buttons:
Start/Stop – test start and stop,
Sett. – access to test settings.

The following fields are displayed on test status menu:
Elaps. – time from the beginning of traffic test
Estim. – time until the end of traffic test
Tx Frames– transmitted frames amount
Rx Frames – received frames amount
Tx bytes – received bytes amount
Vrt, Mbps – current test traffic speed. This data is displayed only during test run.
PDV, ns – average packet jitter value.
Latency – latency value.
Loss frame* – amount of lost bytes equal to the difference between the amount of transmitted frames and the amount received frames. It is displayed in **“Amount”** column. Frame loss ratio is displayed in **“Ratio”** column.
Err. frames – received erroneous frames total amount (Runt, Jabber, CRC) it displayed in “Amount” column. Error ratio is displayed in “Ratio” column.
CRC – amount of received frames with erroneous checksum displayed in “Amount” column. Erroneous frames ratio is displayed in “Ratio” column.

Runts – amount of received frames less than 64 bytes of size with correct checksum is displayed in “Amount” column. Ratio of such erroneous frames is displayed in “Ratio” column.

Jabber – amount of received frames more than 1518 bytes of size with erroneous checksum is displayed in “Amount” column. Erroneous frames ratio is displayed in “Ratio” column.

Pause – total amount of pause frames

*__Note:__ even if frame loss is not detected, loss rate may be equal to a non-zero value. It can be explained by channel latency and sender/receiver buffer latency.

To the left of the status field, an icon indicating current status of the test is displayed. The icon can be as follows:

- **Green** – test passed successfully**;
- **Yellow** – test has not started yet;
- **Red** – test failed;
- **White** – test is disabled;
- – test is running at the moment;
- – test was interrupted by the user;
- – error in test on the far side;
- – error in test: no line synchronization/ line synchronization loss;
- – error in test: no test traffic transmission;
- – error in test: no test traffic reception;
- – error in test: amount of received test frames exceeds the amount of transmitted test frames. It reports problems of network equipment the current measurement interface of the tester is connected to.

When the test is finished, one of the following messages will appear on the display:

- **Test is OK** – test has passed successfully with no frame loss at this load
- **Errors in test** – errors occurred during the test
- **Loss exceeded** – test passed, but some frames were lost at this load.

10.5.2 Settings of Traffic Test for Symmetric Channels

“Header” Tab

The tab contains settings fields similar for all tests with traffic generation. For its description refer to paragraph 10.5.3.

“Adjustment” Tab

Load type – this parameter is not used since it is a constant load test

Units – selection of units in which **Load** is displayed

Load, % – load value

Threshold FLR – if this threshold is exceeded, the test will be considered failed.

Packet length – length of generated frames in bytes

Duration – time duration of the test set in “hh:mm:ss” format. If its value equals zero, the test will run endlessly.

10.5.3 Settings of Tests with Traffic Generation, “Header” Tab

The tab contains setting fields similar for all tests with traffic generation: i.e. “**Traffic Test”**, “**RFC 2544”, “Y.1564”**, “**Packet Jitter”** and **“Multistream”**. Individual settings for each test are stored in Tester memory.

Connection speed, source MAC address, source IP address, VLAN and MPLS measurement interface parameters are specified on **“Interface Settings”** menu. Refer to paragraph 10.20 for description.

Layer 2

ARP enable – function of destination MAC address automatic definition by means of ARP request performed before running the test. When this option is marked, “**Received MAC**” field disappears and its value is disregarded.

MAC Dest. – destination MAC address. If network section under test does not contain routers, destination MAC address will be the address of frame receiving/loopbacking device. Alternatively, destination MAC address will be defined by MAC address of the nearest router.

MAC Source – address of traffic generating interface is set as source MAC address. This field indicates the value specified on **“Interface Settings”** menu.

Layer 3

Marking of this field makes settings of network Layer packet fields available.

Automatical IP Destination – if this field is marked, destination IP address will be similar to opposite port IP address at A->B and B->A test topology.

IP Dest. – destination IP address

IP Source – address of traffic generating interface is set as source IP address. This field indicates the value specified on **“Interface Settings”** menu.

ToS/Precedence – activation/deactivation of QoS settings. Marking of this field blocks DSCP and its value is disregarded. For detailed description of fields refer to RFC 791. ToS field bit names are presented in Table A.1, Appendix A.

Precedence – frame precedence specifies P0-P2 bits in ToS field. It assumes values from 0 to 7. Correspondence of precedence values and names are presented in Table A.2, Appendix A.

ToS – T0-T3 bits in ToS field displayed in binary form. This field can assume the following values: 0000, 0001, 0010, 0100 and 1000.

DSCP – activation/deactivation of QoS settings. Marking of this field blocks **ToS/Precedence** and its value is disregarded. DSCP field bit names are presented in Table A.3, Appendix A. The field may assume values from 0 to 64 and it displays 6 uppermost DS0-DS5 bits from the corresponding frame header byte in binary form. Lettered abbreviation is also displayed (see RFC 2474 and RFC 2597 for more details). Correspondence of precedence values and names are presented in Tables A.4 and A.5, Appendix A.

Layer 4

Marking of this field makes settings of transport Layer packet fields available.

UDP Dest. – destination port number
UDP Source – source port number

Source MAC address, source IP address and VLAN and MPLS fields are set by means of **“Interface Settings”** menu.

10.5.4 Traffic Test for Asymmetric Channels

Note: Traffic Test for Asymmetric Channels is Tester option **08-AT**.

The Tester is connected according to Variant C described in paragraph 10.4. In this case, either “Terminal A>>R” or “Terminal B>>R” mode is to be selected from “Topology” menu.

Traffic Test for Asymmetric Channels always involves two devices. Use of two interfaces of one tester is not appropriate.

“Traffic Test” menu is illustrated in Figure 10.5.2.

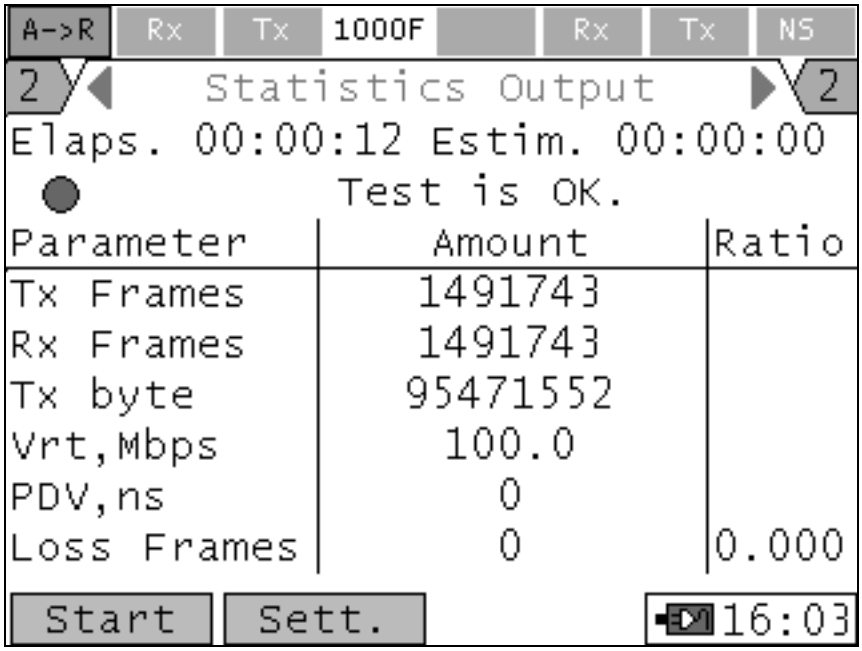

Figure 10.5.2 Traffic Test for Asymmetric Channels

Test menu contains the following two functional keys:
Start/Stop – test start and stop,
Sett. – access to test settings.

Test status menu contains two tabs displaying current and remote point parameters.

Statistics output – measured parameters and values of the outgoing stream, from the current port to a remote point. Tab header field is blue.

Statistics input – measured parameters and values of the incoming stream, from a remote point to the current port. Tab header field is green.

Parameter statistics is analogous to the one described in Paragraph 10.5.1except for:

Rx frames – amount of received frames at the second point.

Unilateral latency is not measured.

Note: Remote point parameters' values are not displayed during test performance.

10.5.5 Settings of Traffic Test for Asymmetric Channels

Test settings menu contains four tabs displaying settings of streams from the current point and from the remote point.

Header output – packet fields' parameters and values for the outgoing stream, from the current port to a remote point. Changeable parameter fields are blue.

Header input – packet fields' parameters and values for the incoming stream, from a remote point to the current port. Fields of changeable parameters are blue.

Additional output – outgoing stream additional parameters.

Additional input – incoming stream additional parameters.

Description is analogous to Paragraph 10.5.2

"Header output" and "Header input" Tabs

The tab contains similar setting fields for all tests with traffic generation. Description is analogous to Paragraph 10.5.3 except for:

ARP request – MAC address identification function is always enabled. The test exchanges management information and telemetering over the third layer.

"Common" Tab

Duration – test duration in "hh:mm:ss" format. If the value equals zero, the test will run endlessly.

Learning Int., ms – waiting time in milliseconds after sending a Learning frame or an ARP request and before frames transmission starts.

Wait Interval, ms – waiting time in milliseconds during which Tester awaits sent frames return from the network.

10.6 RFC 2544 Method

10.6.1 RFC 2544 Test Description

RFC 2544 method is a standard of diversified Ethernet testing. It describes the script of an automated Ethernet channel test procedure with deficient operating traffic. The script contains key parameters for throughput, latency, frame loss and back-to-back testing. Each test allows checking certain parameters described in SLA. Test methodology defines frame sizes, test duration and amount of test repeats.

MAKS-EMK Tester allows running four basic RFC 2544 tests:

- **Throughput**. Evaluation of maximum bit rate. At this rate, amount of test frames transmitted through DUT or network section is equal to the amount of frames sent from test equipment. This test is used for recording maximum switching speed of transport Ethernet elements. Minimum determinable throughput value expressed in % is calculated by the following formula: $\frac{L}{2^{26}}$, where *L* is packet length in bytes.

- **Latency**. Evaluation of time slot during which a frame is transmitted from source to destination and back in accordance with the diagram illustrated in Figure 10.6.1. This value is called round-trip delay. When data is transmitted from one port to another according to test pattern presented in Figure 10.6.2, only one-way delay is measured. Default setting suggests fulfillment of 30 tests regarding whose results average delay is calculated.

  Note: The lowest measurable latency value is equal to 8 ns.

- **Frame loss rate**. Testing a network section or a network device capability of supporting real-time applications (retransmission is not possible). This test allows calculating percentage of frames not transmitted by network element at constant load because of hardware resource deficiency. Please note that high percentage of frame loss is a cause of QoS degradation.

- **Back-to-back**. The test measures the time slot needed to manage maximum load is determined. Test pattern is illustrated in Figures 10.4.1 and 10.4.2. It is mostly used to test such network devices as multiplexers, commutator switches and routers.

MAKS-EMK supports simultaneous two-interface RFC 2544 testing.

10.6.2 RFC 2544 Test Settings

Pressing **Default** button returns all RFC 2544 test settings to default value.

“Header” Tab

This tab contains similar setting fields for all tests with traffic generation. Refer to paragraph 10.5.3 for description.

“Frames” Tab

RFC 2544 method recommends using the following seven preset frame sizes: 64, 128, 256, 512, 1024, 1280 and 1518 bytes at Ethernet testing. These values are set by default. It is possible to set other frame sizes and apply extended RFC 2544 pattern that allows using frames of random sizes including Jumbo frames* from 1519 to 9600 bytes of length. You can also set an additional test frame from 64 to 9600 bytes of length. Frame sizes in bytes should be specified in lines. Field marking allows the corresponding configuration of the frame.

***Note:** Some routers either do not support Jumbo frames or have to be preconfigured to support them. Please familiarize with the specific router documents to estimate the possibility of Jumbo frames support.

“Throughput” Tab

Enable – marking of this field allows running **“Throughput”** test.

Min Loading, % – loading value expressed in percent. Achievement of this value stops **“Throughput”** test. If “zero” value is set, the test will continue until an irreducible load value stated in paragraph 10.6.1 is achieved.

Max Loading, % – percentage loading value at the beginning of **“Throughput”** test for each frame size.

Interval, s – time period of continuous test fulfillment with specified frame sizes and parameter values.

“Latency” Tab

Enable – marking of the field allows running **“Latency”** test.

Iteration – amount of trials of each specified frame size in “Latency” test.

Interval – time period of continuous test fulfillment with specified frame sizes and parameter values.

Manual rates – when the field is marked, “Latency” test will run with the load specified in below settings. Otherwise the test will run with the load being the result of “Throughput” test.

“Frame loss” Tab

Enable – marking of the field allows running **“Frame Loss Rate”** test.

Interval, s – time period of continuous test fulfillment with specified frame sizes and parameter values

Step loading, % – percentage value of loading by which the loading of each successive test stage will decrease in case of frame loss.

First loading, % – percentage value of loading at the beginning of “Frame Loss” test.

Last loading, % – percentage loading value to which “Frame Loss” loading decreases. If frame loss is not detected at any stage, loading will not decrease to the level of final loading value.

“Back-to-back” Tab

Amount – amount of trials in **“Back-to-back”** test for each set frame size.

Enable – marking of this field allows running **“Back-to-back”** test.

Min interval, s – minimum time interval in seconds during which the Tester managed maximum load. It is calculated for each frame size.

Max interval, s – maximum time interval in seconds during which the Tester managed maximum load. It is calculated for each frame size.

“Advanced” Tab

Learning Int., ms – waiting time in microseconds after sending a Learning frame or an ARP request and before frames transmission starts;

Wait Interval, ms – waiting time in microseconds during which Tester awaits sent frames return from the network.

10.6.3 RFC 2544 Test Statistics

“**RFC 2544” Menu** is illustrated in Figure 10.6

Test menu contains three functional buttons:

Start/Stop – test launch and stopping.

Sett. – access to test settings.

Graph – presentation of the selected test results in tabular form or graphically.

Table fields are automatically filled in with current test results. The table contains the following common fields:

Status – the field displays current test status. It may take the following forms:

- **OK** – test passed;
- **Wait** – test has not started yet;
- **Runnin** – test is running at the moment;
- **Stop** – test was discontinued;
- **Off** – test of this frame size is disabled;

– **Error** – “Throughput” test failed because of frame loss at minimum load; “Back-to-back” test failed because of the losses during the minimum time slot;

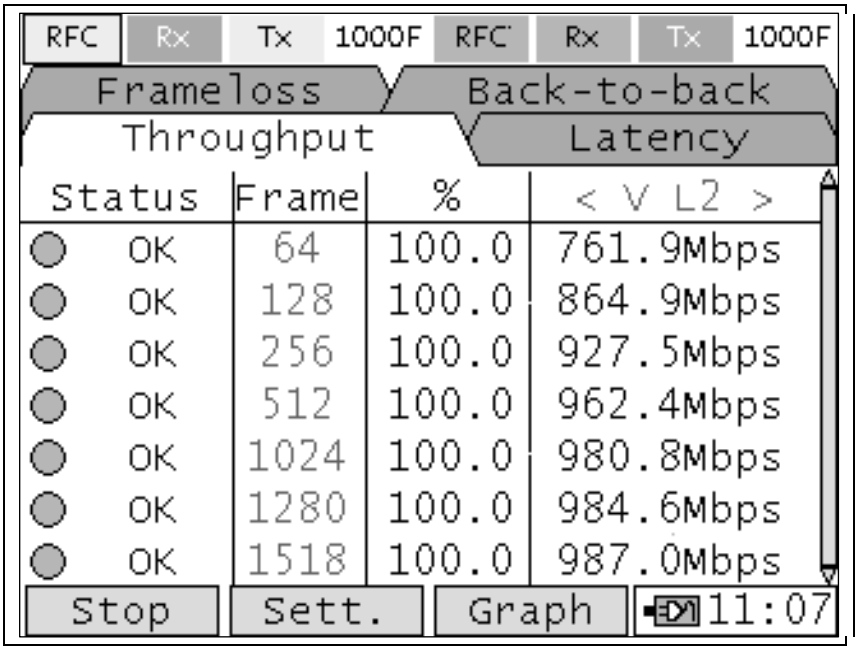

Figure 10.6 RFC 2544 Test

– **NS** – no line synchronization during the test;
– **No Tx** – no test traffic transmission;
– **No Rx** – no test traffic reception;
– **RxTx** – amount of received test frames exceeds the amount of transmitted test frames.

If critical errors occur, the current test will be discontinued and the following test will be launched.

“Frame” – this field shows test packet size in each trial.

“Throughput” Tab

“%” – the field shows measured throughput rate in percentage of maximum channel rate (if the test has been successful). During test run, the field shows current load.

T L1 / T L2 – this field displays throughput value in Mbps, Kbps or bps for Layers 1 and 2. During the test, the field shows current load value.

To select a Layer, press “Down” arrow key and then use “Left” and “Right” arrow keys. Layer 2 throughput value is equal to information speed **V L2**. Maximum throughput value is calculated by the following formula:

$$T_{L2} = V_f \times \frac{S}{(S+P+SFD+IFG)}$$, where

T_{L2} – Layer 2 throughput;
V_f – connection speed (1000 Mbps, 100 Mbps, 10 Mbps);
S – frame size;
P – preamble (7 bits);
SFD – start frame delimiter (1 bit);
IFG – interframe gap (12 bits).

Maximum Layer 1 throughput of a lossless channel is equal to connection speed, i.e. $T_{L1} = V_f$. Maximum Layer 2 throughput is calculated by the above-mentioned formula. T_{L2} values for different frame sizes are presented in Table A.6, Appendix A.

"Latency" Tab

"Load." – the field displays tested loading value expressed as a percentage.

"Latency" – the field shows measured average latency value in ns (if the test was successful). During the test, current measured latency value is displayed in this field.

"Frame loss" Tab

"Load." – this field displays tested load values in %. To view the required column, press **"Down"** arrow key and then select the needed column containing load data using **"Left"** and **"Right"** keys. Frame loss value for the selected load will be displayed in **"Loss"** column. Measurements are performed before the trial which will detect no frame loss. That is why only values of loads that participated in tests are displayed in the table.

"Loss,%" – the field displays frame loss value in % for the selected load.

"Back-to-back" Tab

Quant. – maximum quantity of frames the network device can process without loss.

Max, s – maximum time interval during which the network device can process the traffic without loss.

10.7 Y.1564 Method

10.7.1 Y.1564 Test Description

Note: “Y.1564 test” is Tester option **08-Y1564**.

Y.1564 is a modern method of Ethernet service activation. Methodology of the test is divided in two parts: service configuration test helping to find and correct problems of network configuration and service performance test confirming eligibility for acceptance and service and its permanence in time. Y.1564 method describes the script of Ethernet channel automated test procedure without operating traffic and taking into consideration multi-service network with simultaneous measurement of different services’ (streams’) parameters.

MAKS-EMK tester allows running two simultaneous tests in accordance with Y.1564 method launching up to four streams at each port.

Configuration test - the test assesses guaranteed throughput, exceeded throughput, the throughput value exceeding of which will cause frame loss, frame loss quantity, frame loss ratio, latency and packet jitter.

Performance test – the test is destined to assess frame loss and channel availability ratio.

10.7.2 Test Y.1564 Settings

“UNI” Tab

All parameters are defined in accordance with interface settings of the current port.

Speed – the set data speed between the tester and DUT.

Duplex – the established duplex mode between the tester and DUT.

Interface Type – type of the physical interface established between the tester and DUT.

“Header” Tab

The tab contains settings fields similar for all tests with traffic generation (refer to Paragraph 10.5.3.).

To set frame header for a stream, select the required stream in **“Stream # X”** field**.** To change stream number use **“Enter”** or **“Left”** and **“Right”** keys.

“Streams” Tab

Stream # X – selection of a stream for its configuration. To change the number of the stream, use **“Enter”** or **“Left”** and **“Right”** keys.

Active – when the field is marked, the selected stream will be involved in the test.

Packet length, b – packet length in bytes generated for the selected stream during the test

"SLA" Tab

Stream # X – selection of a stream for its configuration. To change the number of the stream, use **"Enter"** or **"Left"** and **"Right"** keys.

Units – selection of units in which **"CIR"** and **"EIR"** field values for the selected stream will be entered.

CIR – value of maximum guaranteed throughput for the current stream for the criterion of configuration and productivity tests pass.

EIR – value of maximum permissible CIR exceeding for the criterion of configuration and productivity tests pass.

M – maximum permissible exceedance of CIR+EIR value.

Units – selection of units in which **"CBS"** and **"EBS"** field values for the selected stream will be entered.

CBS – value of guaranteed load for the current stream. This parameter shows maximum number of transmitted test traffic bytes CIR conditions being satisfied

EBS – value of maximum permissible load for the current stream.

FLR – maximum permissible value of frame loss ratio for the current stream for the criterion of configuration and productivity tests pass.

FTD, ms – maximum permissible latency for the current stream in ms for the criterion of configuration and productivity tests pass.

AVAIL, % – minimum value of channel availability expressed as a percentage of total productivity test time for the criterion of productivity test pass.

FDV, ms – maximum permissible packet jitter value for the current stream for the criterion of configuration and productivity tests pass.

"Advanced" Tab

Learning Int, ms – waiting time in milliseconds after sending a Learning frame or an ARP request and before transmission of test frames starts;

Wait Interval, ms – time in milliseconds during which Tester awaits the sent test frames return from the network.

Configuration test – marking of this field permits running of configuration test.

Test step, s – trial duration at each step of configuration test.

Step load – marking of this field permits running of configuration test in four stages with load values of 25%, 50%, 75% and 100% from CIR.

Policy – marking allows running of Policy test.

Performance test – marking allows running of Performance test.

Duration – time duration of performance test set in "hh:mm:ss" format

10.7.3 Test Y.1564 Statistics

“Y.1564” test menu is illustrated in Figure 10.7.

Test menu contains two functional keys:
Start/Stop – test start and stop.
Sett. – access to test settings.
During the test, its results are displayed in tables whose fields are filled in automatically as the test runs. The tabs contain the following common fields:
Elaps. – time from the beginning of the test
Estim. – time until the end of the test
Stream #X – selection of a stream to see its test results.

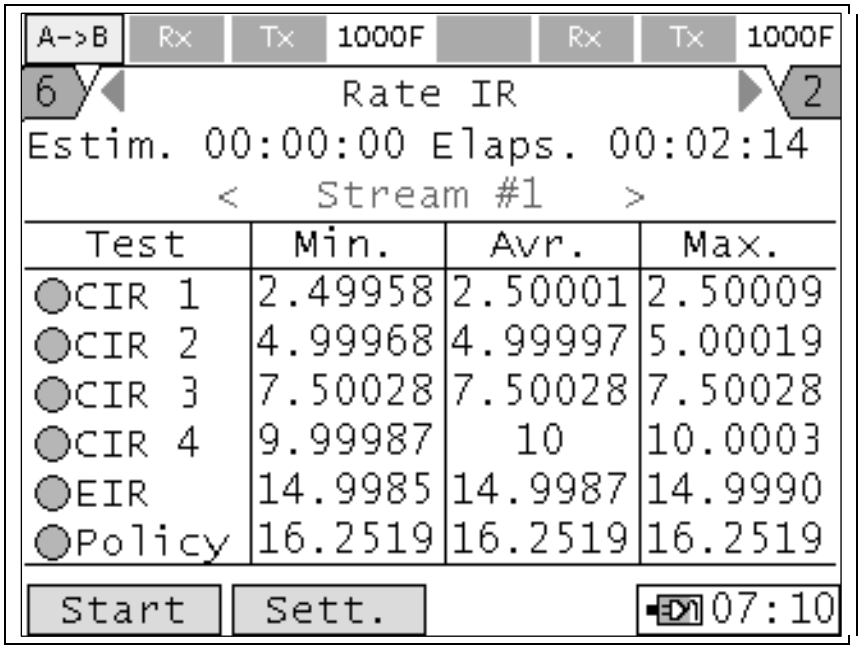

Figure 10.7 Y.1564 Test

Service Configuration Test Statistics
Configuration test statistics includes three tabs: **“Rate IR”**, **“FL Loss”**, **“FTD Latency”**, **“FDV Jitter”**. They all have mutual **“Test”** that contains of the following lines:
CIR1* – the field displays the first step of **CIR** test equal to 25% of the **CIR** value set in “**SLA”** tab.
CIR2* – the field displays the first step of **CIR** test equal to 50% of the **CIR** value set in “**SLA”** tab.
CIR3* – the field displays the first step of **CIR** test equal to 75% of the **CIR** value set in “**SLA”** tab.
CIR4 – when “Step Load” is marked, this field will display the fourth step of **CIR** test equal to unmarked **CIR** value set in “**SLA”** tab.

CIR+EIR – the field displays trial stage with CIR+EIR load.
Policy – the field displays trial stage of Policy test with the load exceeding CIR+EIR.

To the left of **“Test”** column, status icon indicating current status of the test is displayed. Icon values are described in Paragraph 10.5.1.

If errors in CIR or CIR+EIR trials occur, **“Y.1564”** test will stop.

* **Note:** Unless marked, **“Step Load”** field will be deactivated.
** **Note:** The user can consider the test successful if average value of the measured parameter is less than the value specified in test settings.

In the tables of **“Rate IR”**, **“FL Loss”**, **“FTD Latency”** and **“FDV Jitter”** tabs, values of all the measured parameters are displayed for “Test” column of the selected stream.

“Rate IR” Tab
Min. – the column shows minimum measured throughput values.
Avr. – the column shows average measured throughput values.
Max. – the column shows maximum measured throughput values.

“Frame Loss FL ” Tab
Count – the column displays quantity of lost frames.
FLR – the column displays frame loss ratio (FLR).

“Frame Delay FTD ” Tab
Min. – the column displays minimum measured latency values.
Avr. – the column displays average measured latency values.
Max. – the column displays maximum measured latency values.

“Jitter FDV” Tab
Min. – the column displays minimum measured values of packet jitter.
Avr. – the column displays average measured values of packet jitter.
Max. – the column displays maximum measured values of packet jitter.

Performance Test Statistics

Performance Test Statistics tab includes two tabs: **“Performance page #1”** and **“Performance page #2”**. Performance test shall be considered successful if values of the measured parameters are within the allowance specified in its settings.

Productivity test status is displayed above "**Stream #X"** field. It shows current status of the test and can be as follows:

- **OK** – test passed successfully;
- **Wait** – test has not started yet;
- **Runnin** – test is running at the moment;
- **Stop** – test was stopped;
- **Off** – test is disabled;
- **Error** – test was unsuccessful;
- **NS** – no line synchronization/ line synchronization loss during test;
- **No Tx** – no test traffic transmission;
- **No Rx** – no test traffic reception;
- **RxTx** – amount of received test frames exceeds the amount of transmitted test frames. It reports problems of network equipment the current measurement interface of the tester is connected to.

To the left of the status, status icon indicating current status of the test is displayed. Icon values are described in Paragraph 10.5.1.

All the measured parameter values for the selected stream are presented in tabular form in **"Performance page #1"** and **"Performance page #2"** tabs.

"Performance page #1" Tab

Parameter – Performance Test column consisting of the following parameters:

- **FL** – the field displays measured quantity of lost frames;
- **FLR** – the field displays measured value of frame loss rate;
- **AVAIL** – the field displays line availability time in seconds;
- **AVAIL,%** – the field displays value of line availability rate expressed as a percentage of total test time;
- **Value** – the column displays values of measured parameters.

"Performance page #2" Tab

Parameter – Productivity Test column consisting of the following parameters:

- **IR, Mbps** – the field displays measured throughput value;
- **FTD** – the field displays measured latency value;
- **FDV** – the field displays measured packet jitter value;
- **Min.** – the column displays minimum values of measured parameters;
- **Avr.** – the column displays average values of measured parameters;
- **Max.** – the column displays maximum values of measured parameters.

Parameter column fields contain round indicators showing current test status. The indicators can be as follows:

- **Green** – measurement successful;
- **Yellow** – waiting for beginning of measurement;
- **Red** – measurement unsuccessful***;
- **White** – productivity test is disabled****.

*** **Note:** If measured value of frame loss ratio exceeds the maximum permissible value specified in test settings, measurement of **"FL"** and **"FLR"** parameters should be considered unsuccessful. If measured value of line availability ratio is less than minimum permissible value specified in test settings, measurement of **"AVAIL"** and **"AVAIL,%"** parameters should be considered unsuccessful. If measured average value of latency exceeds the maximum permissible value specified in test settings, measurement of **"FTD"** parameter should be considered unsuccessful. If measured average packet jitter value exceeds the maximum permissible value specified in test settings, measurement of **"FDV"** parameter should be considered unsuccessful.

**** **Note: "Performance Test"** field is not marked. If this case, all Productivity Test parameters specified on tabs **"Performance page #1"** and **"Performance page #2"**will be turned off.

10.8 Multistream

Note: "Multistream" test is Tester option **08-MS**.

"Multistream" test is used for simultaneous generation of traffic containing frames with different characteristics.

10.8.1 "Multistream" Test Settings

"Header" Tab

The tab contains settings fields similar for all tests with traffic generation (refer to Paragraph **10.5.3.**).

To set frame header for a stream, select the required stream in **"Stream # X"** field**.** To change stream number use **"Enter"** or **"Left"** and **"Right"** keys.

"Advanced" Tab

Duration – test duration in "hh:mm:ss" format. If the value equals zero, the test will run endlessly.

Stream #X – selection of a stream for its configuration.

Active – if the field is marked, the current selected stream will be used in the test.

Load type – this parameter is not used. The test generates constant load.

Units – selection of units in which **“Load”** field value for the selected stream will be entered.

Load, ms – load value for the selected stream.

Packet length, b – packet length in bytes generated for the selected stream during the test.

10.8.2 “Multistream” Test Statistics

“Multistream” test statistics menu is shown in Figure 10.8.

Test menu contains the following two functional keys:

Start/ Stop – test activation and deactivation.

Sett. – access to test settings.

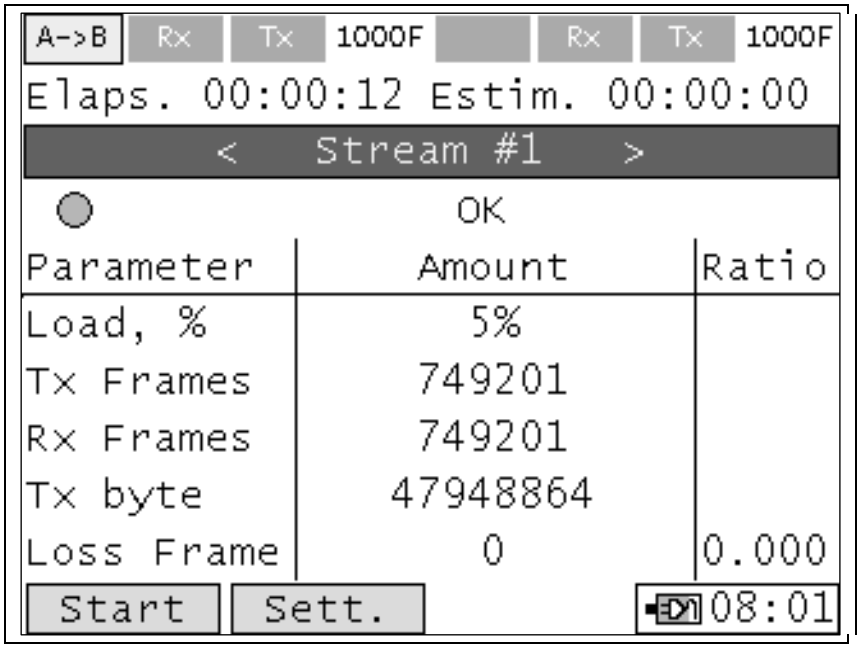

Figure 10.8 “Multistream” Test

The following fields are displayed in “Measurements” field:

Elaps. – time elapsed since **“Multistream”** test launch.

Estim. – time to the end of **“Multistream”** test.

Load – value of generated stream load.

Tx frames – number of transmitted frames in the selected stream.

Rx frames – number of received frames in the selected stream.

Tx byte – number of transmitted bytes in the selected stream.

Loss Frame* – number of lost bytes in the selected stream equal to the difference between transmitted bytes number and received bytes number. It is displayed in “Number” column. Frame loss ratio is displayed in “Ratio” column.

***Note**: during the test, “Loss” field may display a nonzero value even if no frames have been lost. This can be explained by channel latency and sender/receiver buffer latency.

Latency – the measured average latency value of the selected stream (if test was successful). During test run the field displays current measured latency value.

Status of the specific stream is displayed under **“Stream #X”** field. It shows current status of the stream and can be as follows:

- **OK** – test passed successfully;
- **Runnin** – test is running at the moment;
- **Stop** – test was stopped;
- **Off** – test is disabled;
- **Error** – test was unsuccessful;
- **NS** – no line synchronization/ line synchronization loss during test;
- **No Tx** – no test traffic transmission;
- **No Rx** – no test traffic reception;
- **RxTx** – amount of received test frames exceeds the amount of transmitted test frames. It reports problems of network equipment the current measurement interface of the Tester is connected to.

To the left of the status, an icon indicating current status of the test is displayed. Icon values are described in Paragraph 10.5.1.

10.9 Packet Jitter

RFC 3393 defines packet jitter as a delay difference between transmission of two packets. MAKS-EMK Tester allows measuring packet jitter distribution within the range from zero to the upper user-set limit.

10.9.1 Packet Jitter Test Settings

“Header” Tab

The tab contains setting fields similar for all tests with traffic generation. For its description see paragraph 10.5.3.

“Advanced” Tab

Load – shows the tested load value in %

Pack. length, b – length of the generated frames expressed in bytes.

Duration – time duration of the test set in “hh:mm:ss” format.

Threshold, ms – jitter value expressed in microseconds used as the upper limit for jitter distribution.

10.9.2 Packet Jitter Test Statistics

“Report” Menu of **“Packet Jitter”** test is illustrated in Figure 10.9.

“Report” Tab
The tab displays general test results:
Elaps. – time to the end of test.
Estim. – time since test launch
Rx. pack.:
all – amount of received frames.
in order – amount of frames sent and received in the same order, expressed numerically and as a percentage of general frames amount.
not in orde – amount of frames received in an inversed order as against the order they were sent expressed numerically and as a percentage of general frames amount.

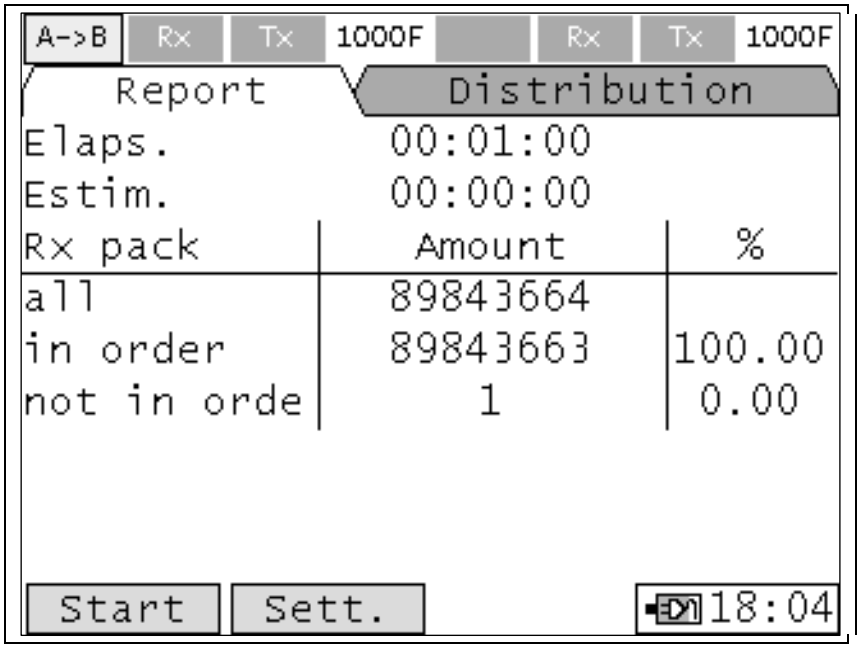

Figure 10.9 Packet Jitter Testing

“Distribution” Tab
Jitter, ms – this column shows ranges of the ten intervals jitter values of the received packets fall within. These intervals are formed by division of the **“Threshold”** value into ten equal parts.
“%” – this column shows number of frames with jitter whose value has fallen within this range, expressed in a percentage of sent frames general number *.
Note: Packets that arrived out of turn do not come into account. So if it happens, total distribution value may be less than 100%**.**
Graph/Table – test results display as a graph or a table.

10.10 PTP Time Synchronization Testing

Note: "PTP" testing is Tester option **08-PTP.**

IEEE1588-2008 PTP standard sets Ethernet model and protocol of time synchronization. The Tester can be configured as a PTP slave device to connect with available PTP master servers and implement time synchronization as well as measure such protocol parameters as packet quantity, one-way and average latency, packet jitter and others.

"PTP" test can be launched from Port A only.

10.10.1 PTP Test Settings

"PTP Settings" Menu

External Clock Setting – this mode is not used.

Unicast – mark this field to select unicast (single-address) mode of PTP synchronization with servers.

Multicast – mark this field to select multicast (multi-address) mode of PTP synchronization with servers.

Duration – time duration of the test set in "hh:mm:ss" format. If its value equals zero, the test will run endlessly.

Domain auto detection – marking of the field sets the mode allowing auto-identification of the domain.

Domain – selection of the domain for work in manual mode

IP PTP Master – field for entering IP address of master device for work in unicast (single-address) mode. When working in multicast (multi-address) mode, the field is blocked.

When the required parameters have been set, enter **PTP Server List menu** by clicking **Select** button**.**

PTP Server List menu by clicking Select button

The menu consists of 10 lines displaying data on PTP servers found on the network. To select a server, place the cursor in the required line containing server information and press **"Done"**.

During multi-address operation, the server selected according to BMCA algorithm will be displayed as "BMCA" in **"Number"** field.

10.10.2 PTP Test Statistics

"PTP" test menu is illustrated in Figure 10.10.

"PTP" menu contains three tabs: **"Information", "Statistics"** and **"Measurements".**

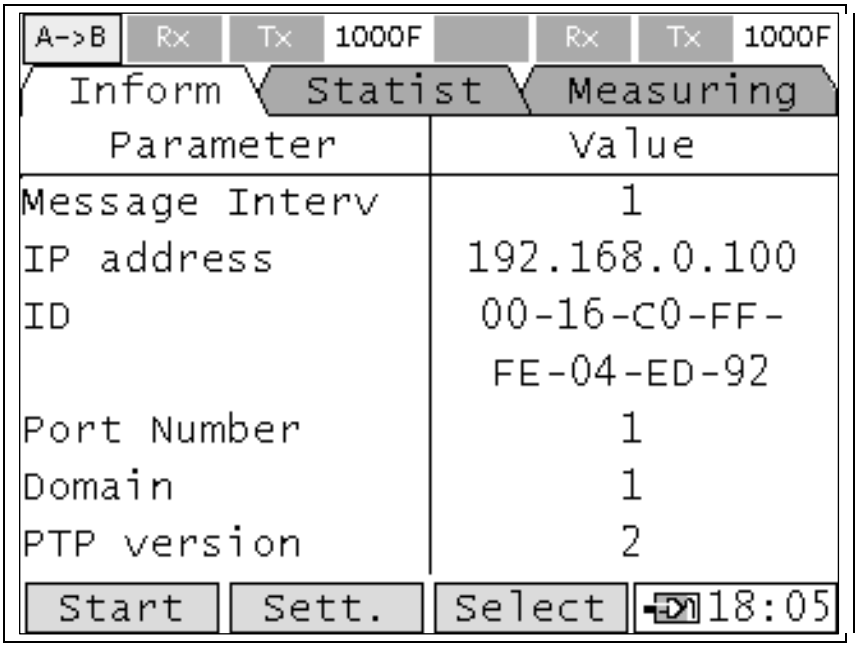

Figure 10.10 PTP Time Synchronization

“Inform” Tab

The tab displays parameters of the selected PTP server:

Message Interv – interval between Announce messages.

IP address – IP address of PTP server.

ID – unique 64 bit PTP server identifier displayed in two lines.

Port Number – refer to IEEE1588 standard describing PTP.

Domain – the domain into which PTP master device is included.

PTP version – protocol version. It can assume values 1 or 2.

Clock Class – this parameter defines qualitative technological accordance of the PTP master device.

Clock Accuracy – this parameter sets minimum time interval characterizing accuracy of time measurement. It is used for defining the best one of the found PTP master devices for BMCA algorithm.

Time Source – information parameter displaying number of the category the time source used by PTP Master belongs to in accordance with IEEE 1588 (see Annex A, Table A.8).

Priority 1 – referential attribute specified in PTP server settings and used in BMCA (the less the value, the higher PTP server priority). Parameter value must belong to the range from 0 to 255.

Priority 2 – referential attribute specified in PTP server settings and used in BMCA (the less the value, the higher PTP server priority). It is used in case selection of the best Master according to basic parameters failed. Parameter value must belong to the range from 0 to 255.

“Statist” Tab

Values column of the table displays sum counters of PTP packets at reception and transmission and single message counters.

Rx frames – all PTP packets received from the server.

Announce –“Announce” packets received from PTP server.

Sync – “Synchronization” packets received from PTP server.

Follow Up – packets with first time stamp received from PTP server.

Delay Resp – packets with third time stamp received from PTP server.

Tx Frames – all PTP packets sent to the server.

Delay Req – PTP packets with second time stamp sent to the server.

“Measuring” Tab

The tab displays values of the parameters measured according to PTP:

Elaps. – time from the beginning of **PTP** test

Estim. – time until the end of **PTP** test

Tms – time delay between PTP master and slave devices showing the difference between the time of **Sync** message reception by PTP slave device and the time of the message sending by master device.

Tsm – time delay between PTP master and slave devices showing the difference between the time of **Delay Request** message reception by PTP master device and the time of the message sending by slave device.

T average – average delay between PTP master and slave devices.

Offset – divergence between PTP master and slave devices’ time scales after first synchronization.

Sync PDV – packet jitter calculated according to **Sync** messages.

10.11 TCP/IP Utilities

10.11.1 Ping test

Ping test is used to check achievability of a certain network node. Frame receiving device, if able to, responds to the ping request sent according to ICMP so that the user could count round-trip delay. Frame loss percentage is also determined. **“Ping test”** menu is illustrated in Figure 10.11.1.

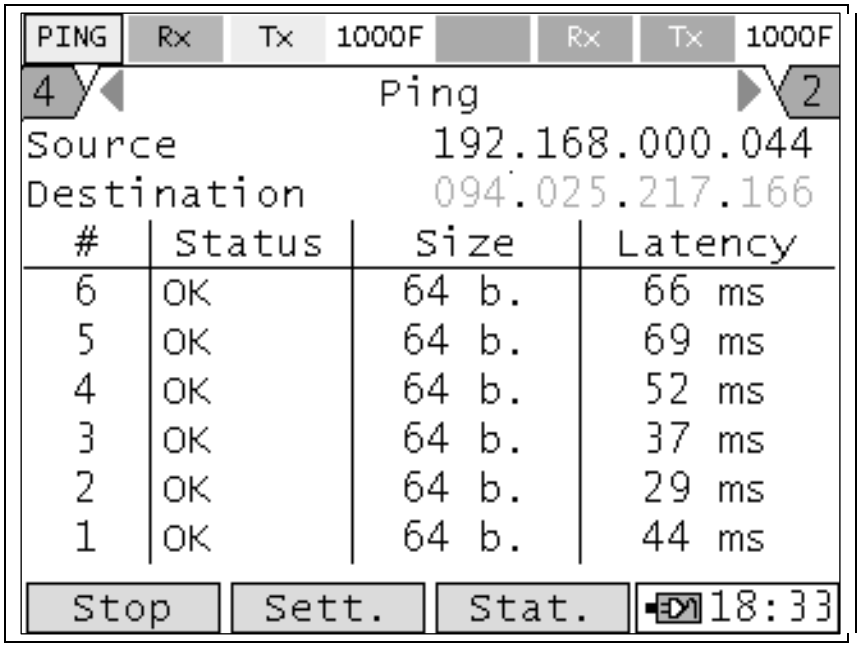

Figure 10.11.1 Ping test

Test result is presented in tabular form. The table shows data on the six latest ping requests as well as statistics on the latest test time slot. The first table column indicates ping request number. The second one shows ping request status that can take the following forms:

- **Request** – ping request was made, but the response message has not been received yet;
- **OK** – ping request was responded correctly;
- **TimeOut** – wait time is over;
- **Intrpt** – wait time for the latest ping request was interrupted by the user.

The third column displays sent frame payload value in bytes. The fourth column shows round-trip propagation delay.

Ping settings

IP address - destination address, address of the device ICMP-packets are sent to in order to check its achievability;

Packet size - packet size in bytes; for networks not supporting jumbo frames maximum ICMP-packet payload size is equal to 1472 bytes;

Wait time, ms – ping response wait time (in ms).

Ping Statistic

In accordance with ping test results, the following measured parameters are displayed:

Sent - sent frames amount;

Received - received frames amount;

Lost - lost frames amount;

Latency
Average - average latency in ms;
Min- minimum latency in ms;
Max - maximum latency in ms.

10.11.2 Traceroute

“Traceroute” test determines frame route in TCP/IP networks. Information on all intermediate routers a frame passes through on its way to the end node is shown in the table formed during test run. “**Traceroute”** menu is illustrated in Figure 10.11.2.

Test result is presented in tabular form. The table shows intermediate node data. The first table column indicates intermediate node number. The second column indicates intermediate node IP address. If wait time is over, the line will display **“timeout”*** message. The third column indicates node response latency. The table is navigated page by page using **“Up”** and **“Down”** arrow keys.

* **Note:** Many network nodes block ability to respond to ICMP frames. In such cases, **“timeout”** message is displayed.

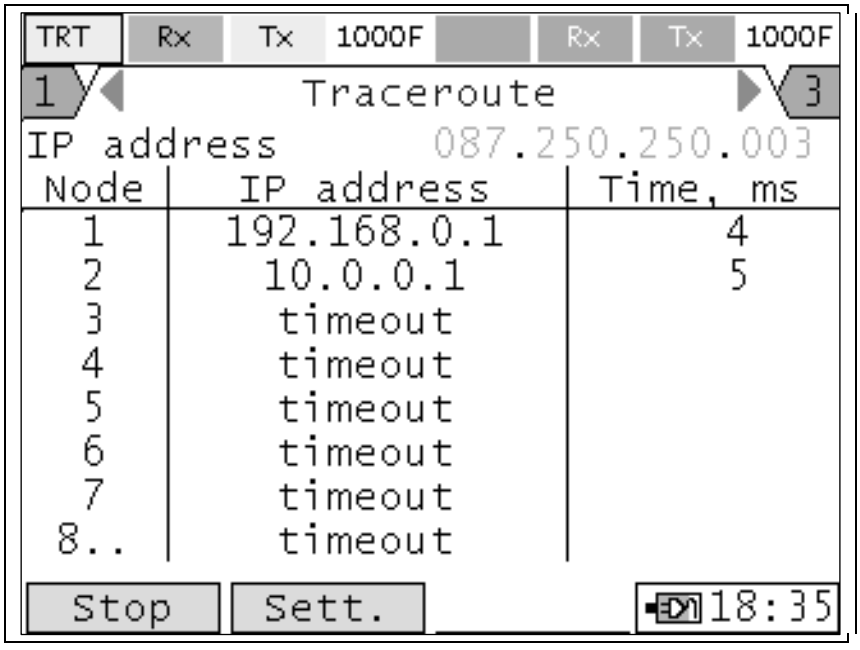

Figure 10.11.2 Traceroute test

Trace Settings
IP address – destination IP address, end node IP address.
Packet size – packet size in bytes.
Wait time, ms – intermediate network node response time.

10.11.3 DNS

DNS (Domain Name System) stands for a distributed system providing information on domains. This function allows getting host IP address by its domain name.

“DNS” menu is illustrated in Figure 10.11.3.

DNS Test Settings

Domain name – domain name according to which DNS request will be made

Status – current test status

Domain IP – received domain IP address

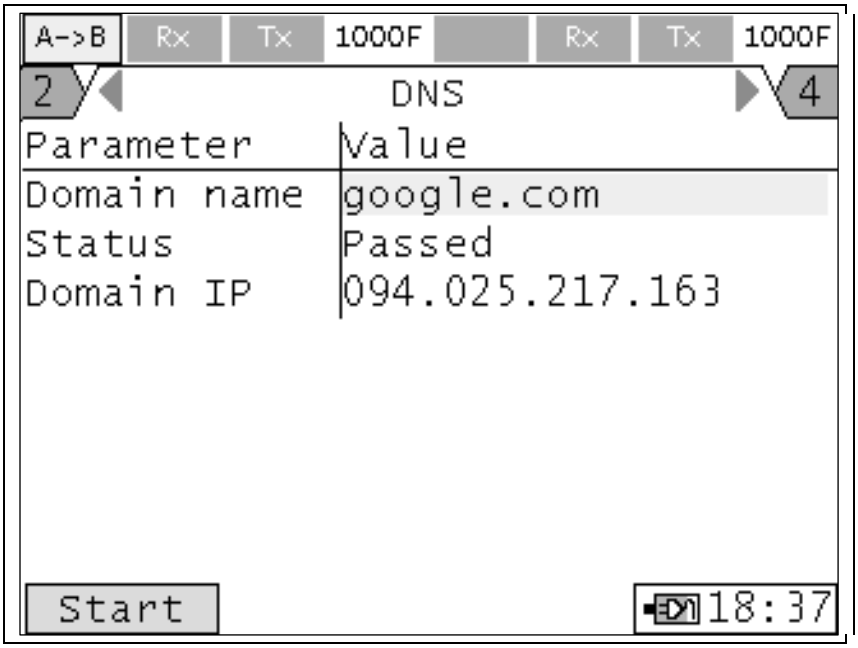

Figure 10.11.3 DNS

“Status” field during DNS test may be as follows:

- **Passed** – test was OK and DNS request was responded
- **In progress** – DNS request was made, test is awaiting response
- **Timeout** – error at test launching (wrong domain name, etc.)
- **“ ”** – test has not been launched.

10.11.4 IP Scanner

IP Scanner feature is designed for detection of network IP addresses responding ARP queries.

“IP Scanner” menu is illustrated in Figure 10.11.4.

Test results are presented in a table showing information on network nodes. The first column indicates node number, the second column – its IP address.

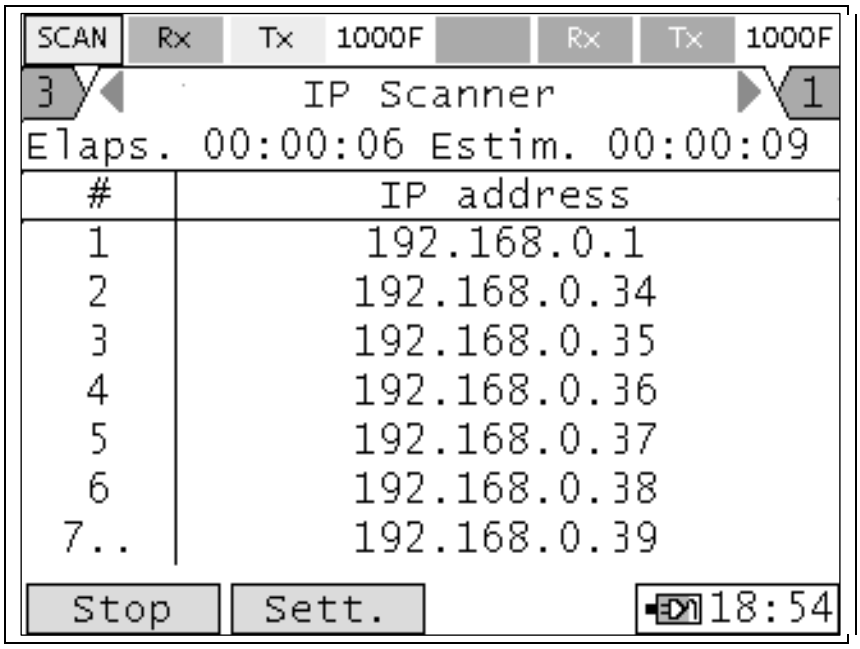

Figure 10.11.4 IP Scanner

IP Scanner Test Settings

First Address – network scanning starts with this IP address

Last Address – network scanning finishes with this IP address

Packet size – length of ARP-request frame in bytes

wait time, ms – waiting time for a reply to the ARP-request from network node expressed in milliseconds

Iteration – quantity of ARP-requests sent to one network node

10.12 Copper Cable Diagnostics

Cable diagnostics is performed in two stages: quality test and determination of twisted pair parameters. Cable quality test is based on breakage diagnostics reflectometric technique that includes distance to fault measurement and cable/plugs fault type definition. Cable quality test is run without in-line synchronization and that is why **Link** LED extinguishes during this test. Each TP of RJ45 connector (1-2, 3-6, 4-5, 7-8) is tested separately.

“Copper Cable Diagnostics” menu is illustrated in Figure 10.12.

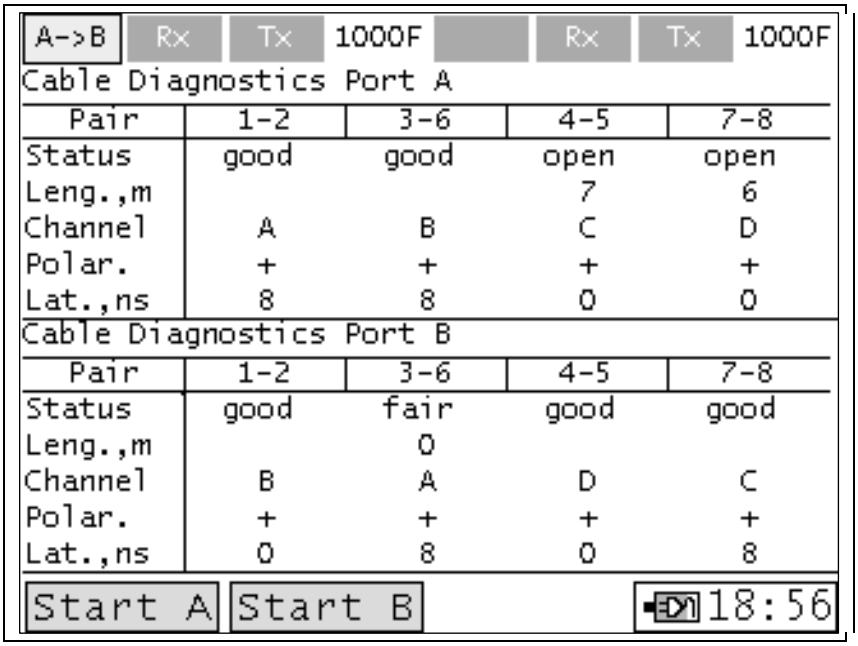

Figure 10.12 Copper cable diagnostics

Cable quality test results displayed in **“Status”** field may be as follows:

- **good** – the cable is OK and is connected to the line;
- **fault** – test not passed*;
- **open** – the pair is open;
- **short** – SC of the pair;
- **fair** – fair/ satisfactory**.

Leng.,m – distance to SC or breakage, or to impulse reflection point (when “Status” field displays **“fair”**). If SC or line breakdown happens, distance to failure will be determined by means of reflectometric technique with the accuracy of +/-1 m. In other cases, cable length is measured with the accuracy of up to 10 m.

Channel* ** – MDI or MDI-X channel (see Table A.7, Appendix A).

Polar. – TP polarity. It can take on the following values: positive “+” or negative “-”.

Lat., ns – selected TP skew latency due to length difference of separate pairs. It shows differential latency of the specified TP with reference to the shortest TP. Measuring inaccuracy is 8 ns.

*** Note:** if during remote point test burst mode of the line was enabled (100 Mbps with no self-matching) and it was not automatically desynchronized.

**** Note:** the TP is not short-circuited or broken but the reflected signal amplitude is low because of plugs/sockets contact fault (as an example).

***** Note:** straight-through cable is self-matched according to MDI-MDIX pattern, crossover cable - according to MDI-MDI or MDIX-MDIX pattern.

TP parameters are determined when line is synchronized.

10.13 Optical Test

This feature provides display of information on SFP modules basic characteristics and real-time parameter monitoring.

"Optical Test" menu is illustrated in Figure 10.13.

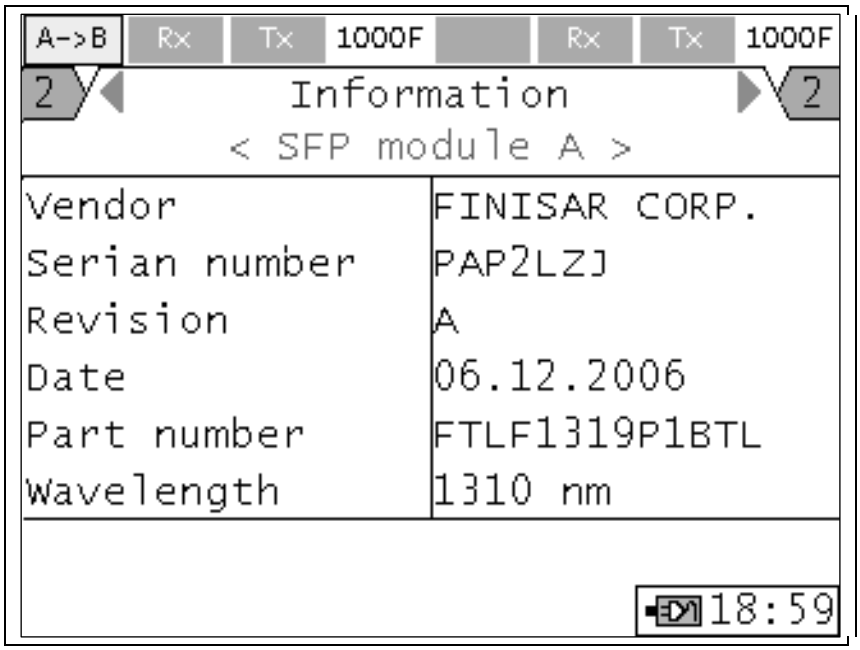

Figure10.13 Optical Test

"Information" Tab

Information on SFP modules inserted into ports A or B is displayed on the screen. To switch between the ports, set the cursor in **"SFP module A(B)"** line and select port A or B using **"Left"** and **"Right"** keys.

The following information is displayed on the menu:

Vendor – SFP module vendor. When no modules are installed, the field will indicate "No SFP module".

Serial number – SFP module serial number according to vendor's nomenclature

Revision – version of the module according to vendor's nomenclature

Date – date of manufacture

Part number – number of module batch according to vendor's nomenclature

Wave length – operating wavelength of SFP module in nm.

“Monitoring (DDM)”* Tab”

The feature provides monitoring of input and output optical power parameters and temperature inside the SFP module.

Test results are presented in a table whose fields are filled automatically during test run. To switch between the ports, set the cursor in **“SFP module A(B)”** line and select port A or B using **“Left”** and **“Right”** keys.

Temperature – current value of temperature inside the SFP in ºC

RX power – current measured value of optical signal input power in mW and dBm

TX power – current measured value of optical signal output power in mW and dBm.

***Note**: Not all SPF modules support digital parameter control feature.

10.14 Remote OAM Management

OAM protocol functions allow MAKS-EMK Tester displaying information on remote point supported modes and also activate loopback mode at a remote point.

“OAM” menu is illustrated in Figure 10.13. It includes the following settings:

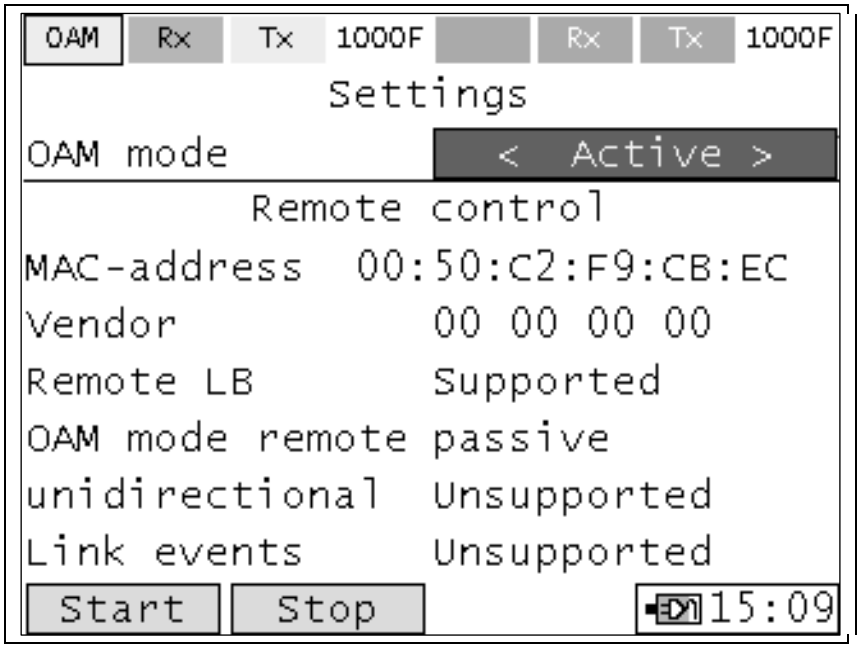

Figure 10.14 Remote OAM management

OAM mode – OAM mode selection for this port may be as follows:

- **Active** – port can respond OAM commands of remote devices, it regularly sends OAM discovery commands and it can activate Layer1 loopback mode at a remote device.

- **Passive** – port can only respond to remote devices' OAM commands
- **Off** – function is switched off

"Remote Control" tab - displays remote point operation modes and settings. It contains the following fields:

MAC-address – MAC address of the discovered remote device

Vendor – remote device unique identifier

Remote LB – activation of loopback mode by a remote device

OAM mode remote – remote device OAM mode. See description above.

unidirectional – remote device unidirectional connection

Link Events – notifications of remote device connection errors.

If the remote device supports Loopback activation function, Loopback can be activated /deactivated using **"Start"** and **"Stop"** buttons.

Note: it is necessary to deactivate OAM function at the port generating test traffic or enable its passive mode before running tests with traffic generation.

10.15 BER Test

10.15.1 BER Test Description

BER test represents Layer 1 test allowing the user to check a channel for bit errors. Bit Error Rate (BER) is equal to a ratio of received erroneous bits to the total bits received.

BER test is not suitable for testing of network sections containing Layer 2 and Layer 3 network equipment because it may cause packet loss.

When a network section looped up according to Variant A (see Figure 10.4.1) is tested, it is necessary to activate Layer 1 loopback at the remote point.

"BERT" menu is illustrated in Figure 10.15

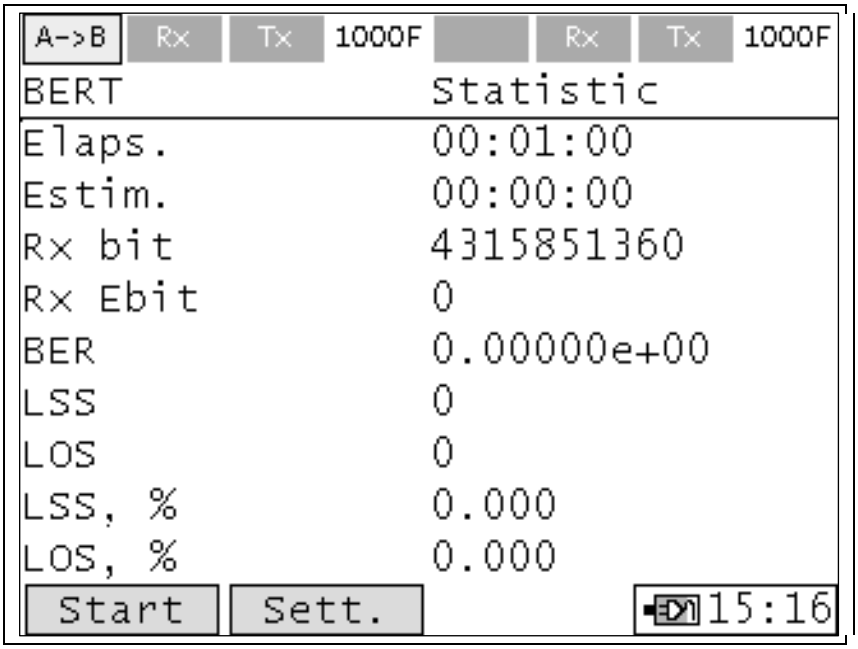

Figure 10.15 BER test

The following fields are displayed on test status menu:
Elaps. – time from the beginning of BER test
Estim. – time until the end of BER test
Rx bit – amount of received bits
Rx Ebit – amount of received erroneous bits
BER – ratio of received erroneous bits to total bits received
LSS – amount of seconds without pattern synchronization
LOS – amount of seconds without line synchronization
LSS,%% – ratio of time with no test pattern synchronization to elapsed time
LOS,%% – ratio of time with no line synchronization to elapsed time

10.15.2 BERT Settings

The following fields are displayed on **Settings** menu:
Pattern type – pattern type selection: user pattern specified in **User Pattern** field, PRBS $2^{11}-1$, $2^{15}-1$, $2^{20}-1$, $2^{23}-1$, $2^{29}-1$, $2^{31}-1$, CRTP.
User Pattern – 32 bits of user pattern
Frame size – frame size in bytes
Units – units in which load value is set: % or bps
Load, % – load value in % or bps.
Duration – time duration of the test set in “hh:mm:ss” format. If its value equals zero, the test will run endlessly.
Offset, bytes – offset value in bytes after **Preamble** field. After **Preamble** field text sequence can be inserted.

10.16 Testing of MDI IPTV Video Data Transmission

Note: "MDI" test is Tester option **"08-IPTV"**.

MDI test can be used as a primary diagnostics tool and quality indicator of video data transmission. The test corresponds to RFC 4445 recommendation and uses two test features: Media Loss Rate (MLR) and Delay Factor (DF).

"MDI Test" menu is illustrated in Figure 10.16.

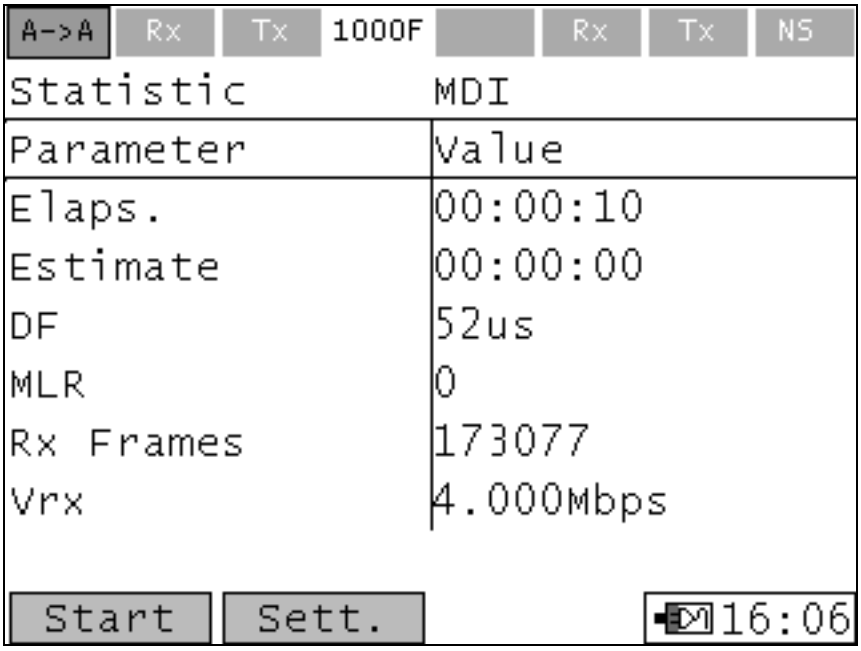

Figure 10.16 MDI Test

10.16.1 MDI Test Settings

"UNI" Tab

All parameters are defined in accordance with interface settings of the current port.

Speed – the set data speed between the tester and DUT.

Duplex – the established duplex mode between the tester and DUT.

Interface Type – type of the physical interface established between the tester and DUT.

"Header" Tab

The tab contains settings fields similar for all tests with traffic generation (refer to Paragraph 10.5.3.).

“Advanced” Tab

Duration – time duration of the test set in “hh:mm:ss” format. If its value equals zero, the test will run endlessly.

Units – selection of units in which **Load** is displayed.

Load, % – load value

Threshold FLR – if this threshold is exceeded, the test will be considered failed.

Packet length, b – packet length in bytes generated during the test

Learning Int., ms – waiting time in microseconds after sending a Learning frame or an ARP request and before frames transmission starts.

10.16.2 MDI Test Statistics

The following fields are displayed in test statistics menu:

Elaps. – time elapsed since **“MDI”** test launch.

Estim. – time to the end of **“MDI”** test.

DF – delay factor. The coefficient is constantly being verified during the test.

MLR – media loss rate. Takes account of lost frames and frames received in no particular order. The coefficient is constantly being verified during the test.

Rx Frames – received frames amount.

Vrx – average value of test traffic rate at reception calculated for Layer 4 during the last second.

10.17 Loopback Testing

Tester is connected to a network or a network device according to the diagram presented in Figure 10.17. MAKS-EMK allows activation of two independent loopbacks at both USB ports or loopback activation at one port and any other available function at the second one.

10.17.1 Loopback Settings, “Common” Tab

“Loopback” function allows testing a network without changing its settings. Such a test can be run at different OSI Layers:

- **at physical layer:** all incoming frames are looped back inversely. At that, their structure does not undergo any changes.
- **at data link layer:** incoming frames are looped back inversely. It is possible to activate algorithm of source and destination MAC address swapping and algorithm of MAC address shifting at loopback. Frames

containing identical source and destination MAC field data, OAM frames, ARP requests and multicast frames are hard filtered at reception and are not looped back inversely.

- **at networking layer:** incoming frames are looped back inversely. It is possible to activate algorithm of source and destination IP address swapping at loopback. When network Layer loopback is activated, settings of the above mentioned swapping and shifting algorithms at data link Layer will also be effective.

Status – selection and activation of the Layer to be looped back. You can change the mode by means of **Enter** key and **Left** and **Right** arrow keys. The field may look as follows:

Off – deactivation of **"Loopback"** function.
Layer 1 – physical loopback activation.
Layer 2 – data link loopback activation.
Layer 3 – networking loopback activation.
Layer 4 – transport loopback activation.

Press **"Set"** button to change mode.

When loopback at any layer is activated, layer settings will be blocked and available in view-only mode.

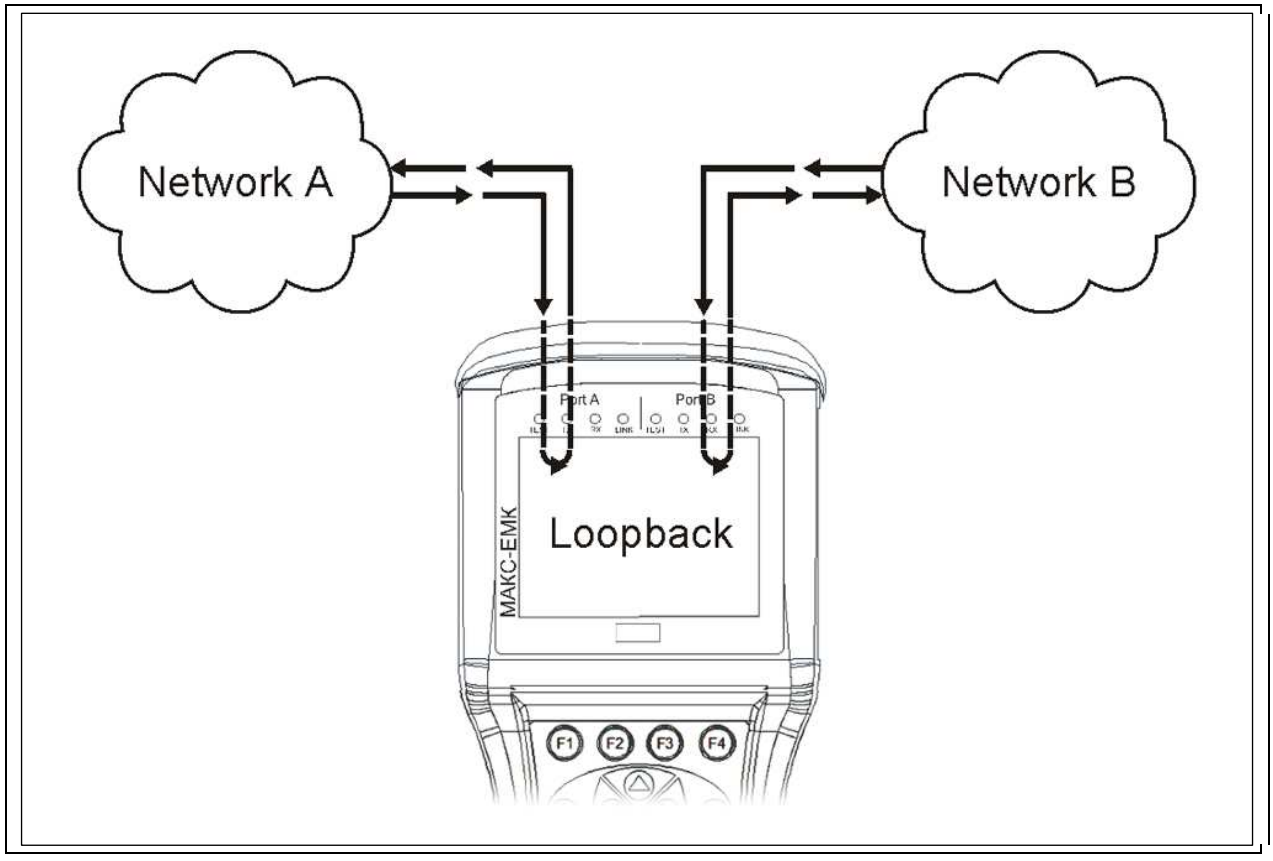

Figure 10.17 Loopback Mode Connection Diagram

10.17.2 Second Layer Loopback Settings

If **“Replace MAC”** is not marked, Layer 2 loopback activation will lead to automatic swapping of source and destination MAC address frame fields.

Replace MAC – marking of **“Source**” and **“Destination”** fields results in swapping of source and destination MAC addresses of the received frames for source and destination MAC addresses specified in the corresponding fields.

Source – specifies new source MAC address.

Destination – specifies new destination MAC address.

VLAN – marking activates VLAN-VID swapping. VID field of the received packet is swapped for the value from the corresponding field.

Priority – swapping of transmitted traffic priority (IEEE 802.1p standard). PCP field of the received packet is swapped for the value from the corresponding field.

10.17.3 Third Layer Loopback Setting

If **“Replace IP”** is not marked, Layer 3 loopback activation will result in automatic swapping of source and destination fields of IP address frame.

Replace IP – marking of **“Source**” and **“Destination”** fields results in swapping of source and destination IP addresses of the received frames for source and destination IP addresses specified in the corresponding fields.

Source – specifies new source IP address.

Destination – specifies new destination IP address.

ToS/Precedence – marking activates swapping of ToS field with QoS parameters. Marking of this field blocks **DSCP** installation and its value is disregarded. Refer to RFC 791 for detailed field description. ToS field bit names are listed in Appendix A, Table A.1.

ToS – this field specifies new value of ToS byte T0-T3 bits. It is displayed in binary form and may assume the following values: 0000, 0001, 0010, 0100, 1000.

Precedence – specifies new value of ToS byte P0-P2 bits. It can assume values from 0 to 7. Correspondence of precedence names and their values are shown in Appendix A, Table A.2.

Replace DSCP – marking of this field activates swapping of DSCP field with QoS parameters and blocks **ToS/Precedence** installation and its value is disregarded. DSCP field bit names are listed in Appendix A, Table A.3. The field may assume values from 0 to 64, it displays 6 uppermost DS0-DS5 bits of the corresponding frame header byte in binary form. Alphabetic abbreviation (refer to RFC 2474 and RFC 2597 for more detailed information) is also

displayed. Correspondence of DSCP names with their values are shown in Appendix A, Tables A.4 and A.5.

10.18 Thru Mode

“Thru” mode allows optical/electrical Ethernet traffic monitoring and analysis. You should connect MAKS-EMK to the gap between two network sections or two network devices as illustrated in Figure 10.18. At that, the traffic received from port A will be forwarded to port B and the traffic received from port B will be forwarded to port A. **“Thru”** mode can also be used to convert one Ethernet standard into another. Thus, you can convert optical 1000BASE-X Ethernet into electrical 1000BASE-T Ethernet and others.

Statistics on received and transmitted frames is displayed on **“Statistics”** menu. If connection speed values of two ports differ, frame loss during transmission from the port with higher connection speed to the one with lesser speed will be acceptable.

Reception and transmission speeds at both ports in **“Thru”** mode are displayed in “Statistics” menu.

To activate **“Thru”** function, mark the corresponding menu option (see Figure 10.2).

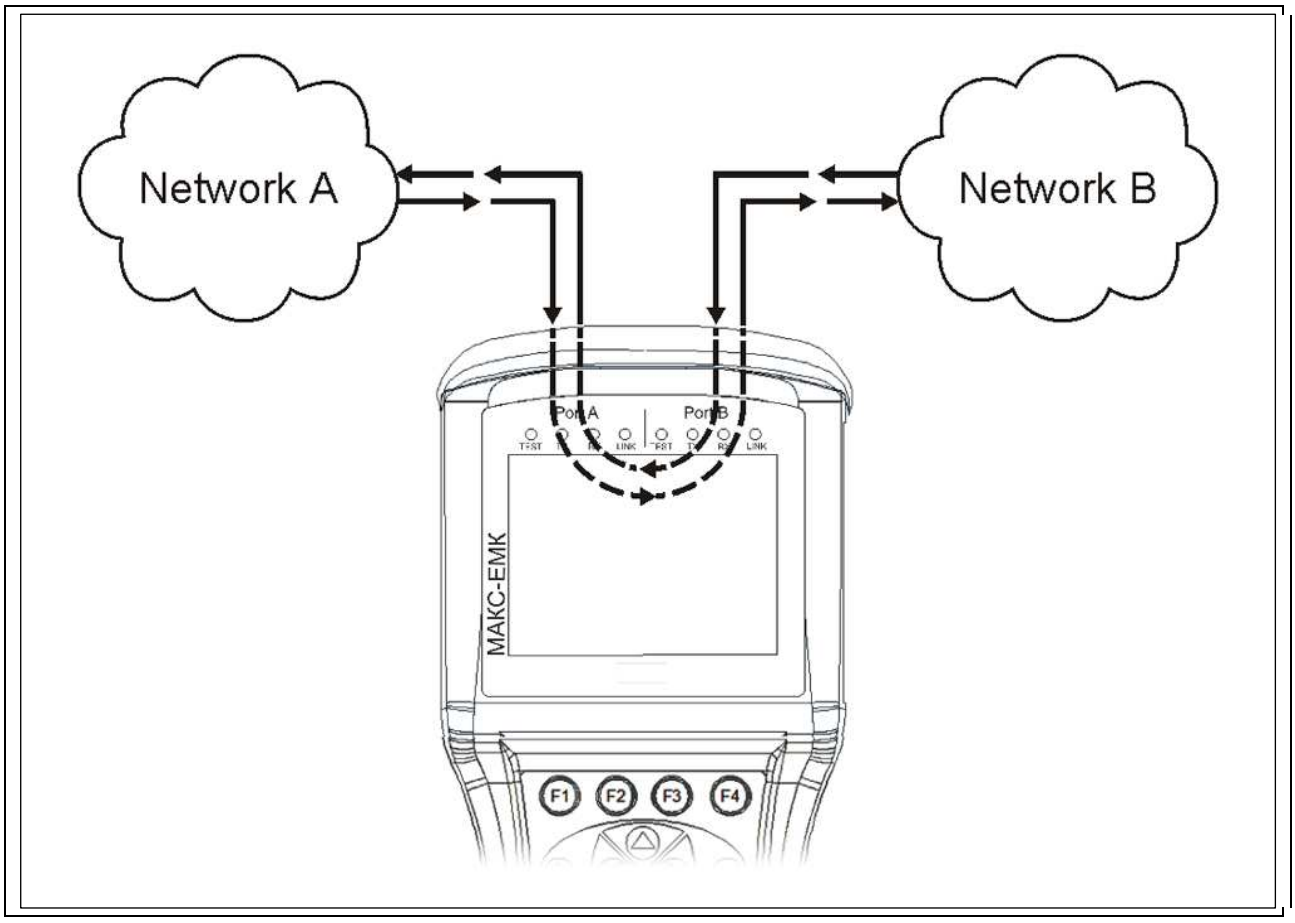

Figure 10.18 **“Thru”** mode connection diagram

10.19 Statistics

Tester collects statistics on the received and transmitted frames. Statistics information is sorted as to Layers, frame types, frame sizes and erroneous frames. **“Statistics”** menu appearance is illustrated in Figure 10.19.

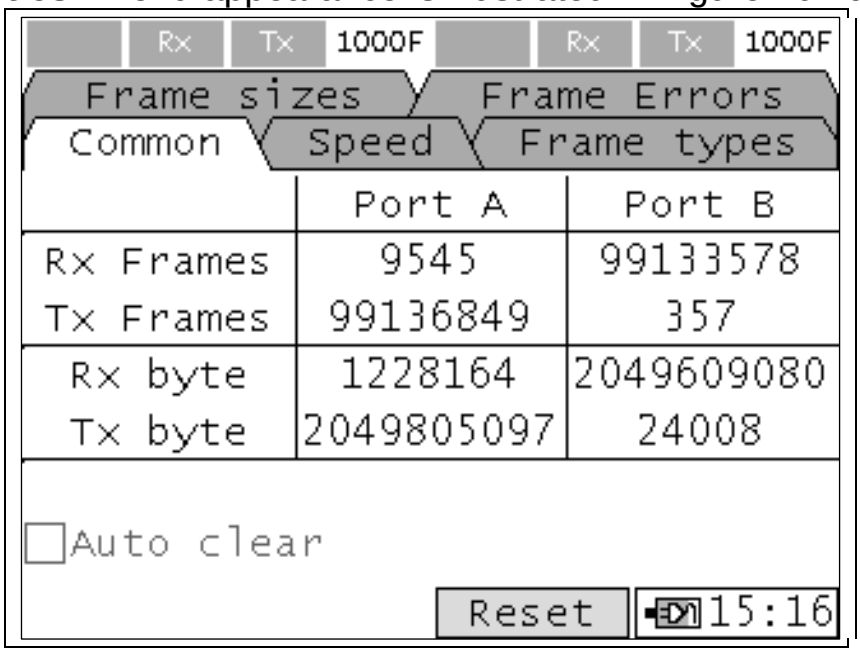

Figure 10.19 Statistics

10.19.1 “Statistics” Menu Options

“Common” Tab

Fields display received and transmitted data for ports A and B expressed in bytes and frames.

Rx Frames – amount of received frames

Tx Frames – amount of transmitted frames

Rx byte – amount of received bytes

Tx byte – amount of transmitted bytes

Auto clear – when marked, all statistics information will be reset each time a new test with traffic generation is launched (**RFC 2544**, **Y.1564, Traffic test**, **Packet jitter**, **Multistream**, **BERT**).

To reset all accumulated statistics values, press **“Reset”** button.

To save a statistics report, press **“Save”** button, enter file name and press **“Save”** again.

“Speed” Tab

V L1 – Layer 1 reception and transmission speed for both ports in bps;

V L2 – Layer 2 reception and transmission speed for both ports in bps. Its values can be interpreted as instantaneous values of data reception and data transmission speeds without regard to preamble, interframe gap and start frame delimiter.

Maximum Layer 2 speed at interfaces is calculated by the following formula:

$$V_i = V_f \times \frac{S}{(S+P+SFD+IFG)}$$, where

V_i – information rate;
V_f – connection speed (1000 Mbps, 100 Mbps, 10 Mbps);
S – frame size;
P – preamble (7 bits);
SFD – start frame delimiter (1 bit);
IFG – interframe gap (12 bits).

V L3 – Layer 3 reception and transmission speed for both ports in bps.

“Frame Types” Tab
Broadcast – broadcast frames
Multicast – multicast frames
Unicast – unicast frames
Pause – pause frames
Rx A – amount of frames received at port A
Tx A – amount of frames transmitted at port A
Rx B – amount of frames received at port B
Tx B – amount of frames transmitted at port B

“Frame Sizes” Tab
size – frame size (in bytes)
Rx – received frames amount
Tx – transmitted frames amount
In order to see statistics on another port, enter the tab using **Enter** key and select the required port using **“Left”** and **“Right”** arrow keys.

“Frame Errors” Tab
CRC – amount of received frames with checksum error
Runts – amount of received frames of less than 64 bytes in length with correct checksum
Jabber – amount of received frames of more than 1518 bytes in length with checksum error.

10.20 Memory

MAKS-EMK Tester is equipped with embedded non-volatile 488-records memory used for saving settings and test results. **“Memory”** menu contains two tabs: **“Settings”** and **“Results”**. Settings menu is illustrated in Figure 10.20.

“Settings” Tab

To save current test and interface settings, place cursor in “**Curent”** line and press **“Save”**. Then, enter record name and press **“Save”**.

To upload or delete previously saved records, position the cursor in the line containing the required record and press **“Load”**, **“Delete”** or **“Del. all”**.*.

“Results” Tab

Result saving window appears each time the user presses **“Menu”** button after a test finishes. To save results of the performed test, enter file name and press **“Save”**. To cancel saving, the user is to press **“Cancel”** button. Saved entries are displayed on **“Results”** tab of **“Memory”** menu.

To upload or delete previously saved entries, position the cursor in the line containing the required record and press **“Load”**, **“Delete”** or **“Del. all”**.*

***Note:** When tests are running it is impossible to upload settings or results from the memory. You have to discontinue all tests first.

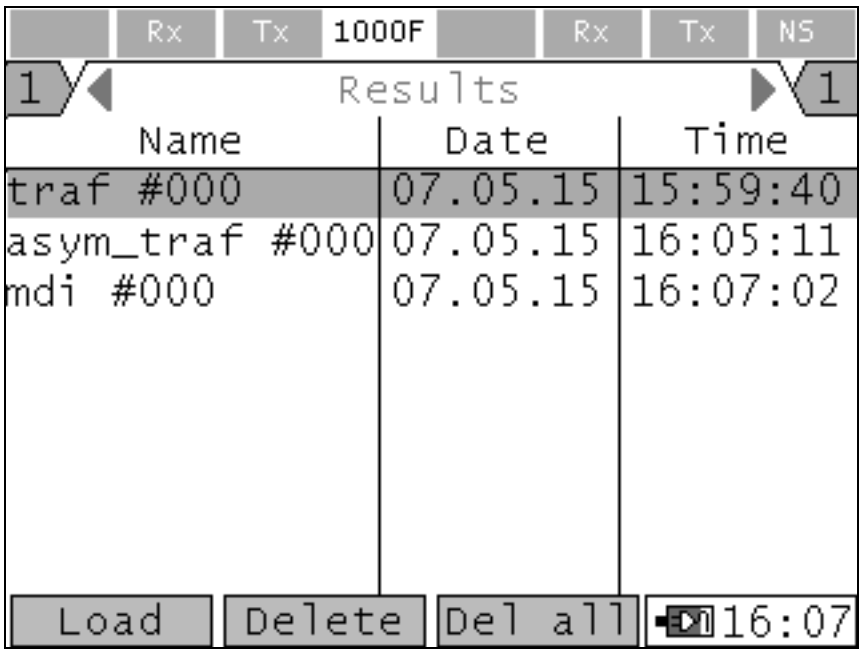

Figure 10.20 Memory

10.21 Interface Settings

“Interface Settings” menu displays settings of measurement ports A and B and remote management port with an RJ-45 connector denoted as follows: .

“Interface Settings” menu is illustrated in Figure 10.21.1.

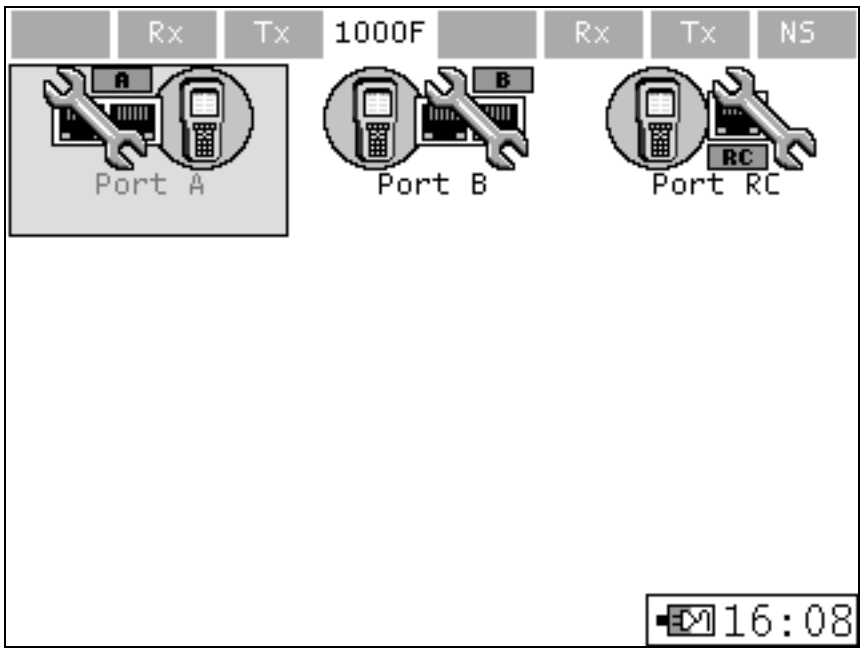

Figure 10.21.1 Interface Settings

“Interface Settings” menu opens access to the menu containing settings of each port.

Settings menu is illustrated in Figure 10.20.2.

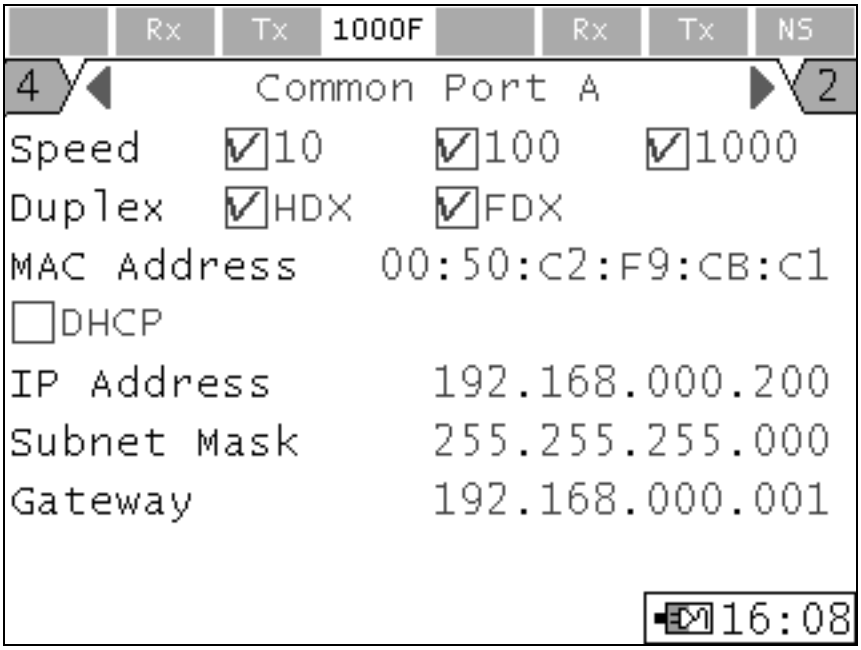

Figure 10.21.2 **“Interface Settings”** menu, **“Common”** tab

“Interface Settings” menu of each port contains four tabs: **“Common Port A(B)”**, **“VLAN Port A(B)”**, **“MPLS Port A(B)”** and **“Packet Filter Port A(B)”.**

“Common Port A(B)” tab

Speed – data transmission speed selection. When **“10”**, **“100”** and **“1000”** options are marked, connection will be configured automatically at the highest possible speed. If only one option is marked, connection will be forcedly configured for the selected speed *. Unmarking of all fields activates speed field markings of the current port.

Duplex – **half duplex** (**“HDX”**) or **full duplex** (**“FDX”**) mode selection. Mark one or both fields.

MAC Address – MAC address of the configured port **: A, B or LAN. The tester has a default base of MAC addresses for all ports from the range reserved by the manufacturer but any address can be edited manually.

DHCP* – as soon as this function is activated, port IP address, subnet mask and other parameters will be received automatically from DHCP server.

IP Address – subnet IP address

Subnet Mask – subnet mask

Gateway – subnet gateway

Settings are applied after pressing **“Set”** button. The button appears when current commons settings are changed.

*** Note:** When Tester is connected optically via SFP modules, transmission speed is always selected automatically and is equal to 1,000 Mbps regardless of any marked options.

**** Note:** New MAC address of the port will be valid only after Tester reloading.

****** Note:** If Loopback function is activated at the actual interface, DHCP will not run. In order to activate it, you will first have to deactivate Loopback and receive DHCP settings.

"VLAN Port A(B)" Tab

VLAN**** – VLAN parameters activation/deactivation (according to IEEE 802.1q and IEEE 802.1p standards). Assumes values equal to the number of VLAN tags (from 0 to 3) to be inserted into frame. If the value is equal to zero, traffic will be generated without VLAN. To change quantity of VLAN tags, press **"Right"** and **"Left"** keys.

TPID – tag protocol identifier

PCP – transmitted traffic Precedence (for IEEE 802.1p standard)

VID – 4 bytes long VLAN identifier; values can be set within the range of 0…4095.

****** Note:** One VLAN tag takes up 4 bytes. When VLAN is on, minimal lengths will make up 68 bytes for one VLAN tag, 72 bytes – for two VLAN tags and 76 bytes – for three VLAN tags because of frame tag fields lengthening. If a lesser frame sizes is set, an error report will be displayed. RFC 2544 test with default frame size values (i.e. 64 bytes and more) will not run.

"MPLS Port A(B)" Tab

Note: MPLS Settings are Tester options **"08-MPLS"**.

MPLS* – MPLS parameters activation/deactivation. Assumes values equal to the number of MPLS tags from 0 to 3. If the value is equal to zero, traffic will be generated without MPLS tags. To change the amount of MPLS tags, press **"Right"** or **"Left"** keys.

Value – tag value

QoS – class of packet service

TTL – packet lifetime

***Note**: One MPLS tag takes up 4 bytes.

Simultaneous activation of VLAN and MPLS tags leads to cumulative frame length increase.

When MPLS tags are active, minimal lengths will make up 68 bytes for one MPLS tag, 72 bytes – for two MPLS tags and 76 bytes – for three MPLS tags because of frame tag fields lengthening. If lesser frame sizes are set, an error report will be displayed. RFC 2544 test with default frame size values (i.e. 64 bytes and more) will not run.

“Packet Filter Port A(B)” Tab

Packet filtering parameters are set on this tab. It is acceptable to select several filtering variants. Packets satisfying the conditions of filtering will come into account in test results.

MAC Dest. – marking enables packet filtering as per the set destination MAC address. At that, only packets satisfying the condition will be accounted in test results.

MAC Source = MAC Dest. – marking enables filtering of packets with similar source and destination MAC addresses. At that, packets satisfying the condition will be deleted from test results.

IP Dest. – marking enables packet filtering as per the set destination IP address. At that, only packets satisfying the condition will be accounted in test results.

IP Source = IP Dest. – marking enables filtering of packets with similar source and destination IP addresses. At that, packets satisfying the condition will be deleted from test results.

VLAN ID 1 – marking enables filtering of packets as per the set identifier of the first VLAN tag. At that, only packets satisfying the condition will be accounted in test results.

VLAN ID 2 – marking enables filtering of packets as per the set identifier of the second VLAN tag. At that, only packets satisfying the condition will be accounted in test results.

Settings are applied after pressing of **“Set”** button appearing after current filtering settings have been edited.

10.22 Remote Management

Remote MAKS-EMK management allows configuring Tester parameters, setting and launching tests as well as viewing and saving test results. USB port denoted and LAN port denoted serve for remote management of the Tester.

10.22.1 Remote Management via USB

USB port (see Figure 4.1.4) is used for remote MAKS-EMK management. To organize an interface between Tester and PC you should install driver package for virtual **CP210x_VCP_Win2K_XP_S2K3.exe.** COM port emulation. When the driver is installed, connect the Tester to PC via USB cable. New COM port will appear on Device Manager.

10.22.2 Remote Control via Ethernet

Note: Remote Control via Ethernet is Tester option **08-RC**.

To manage the Tester, connect it to connector by means of a patch-cord (see Figure 4.1.4). Configure the third Ethernet interface serving for remote management using **“Interface Settings”** menu, then **“Interface Settings RC”**.

10.22.3 Remote Control Software Operation

Start EMKRemote.exe program. Dialogue box of the program is illustrated in Figure 10.21. The program is common for MAKS-EMK and MAKS-EMBK but it can manage only one Tester/Tool at a time.

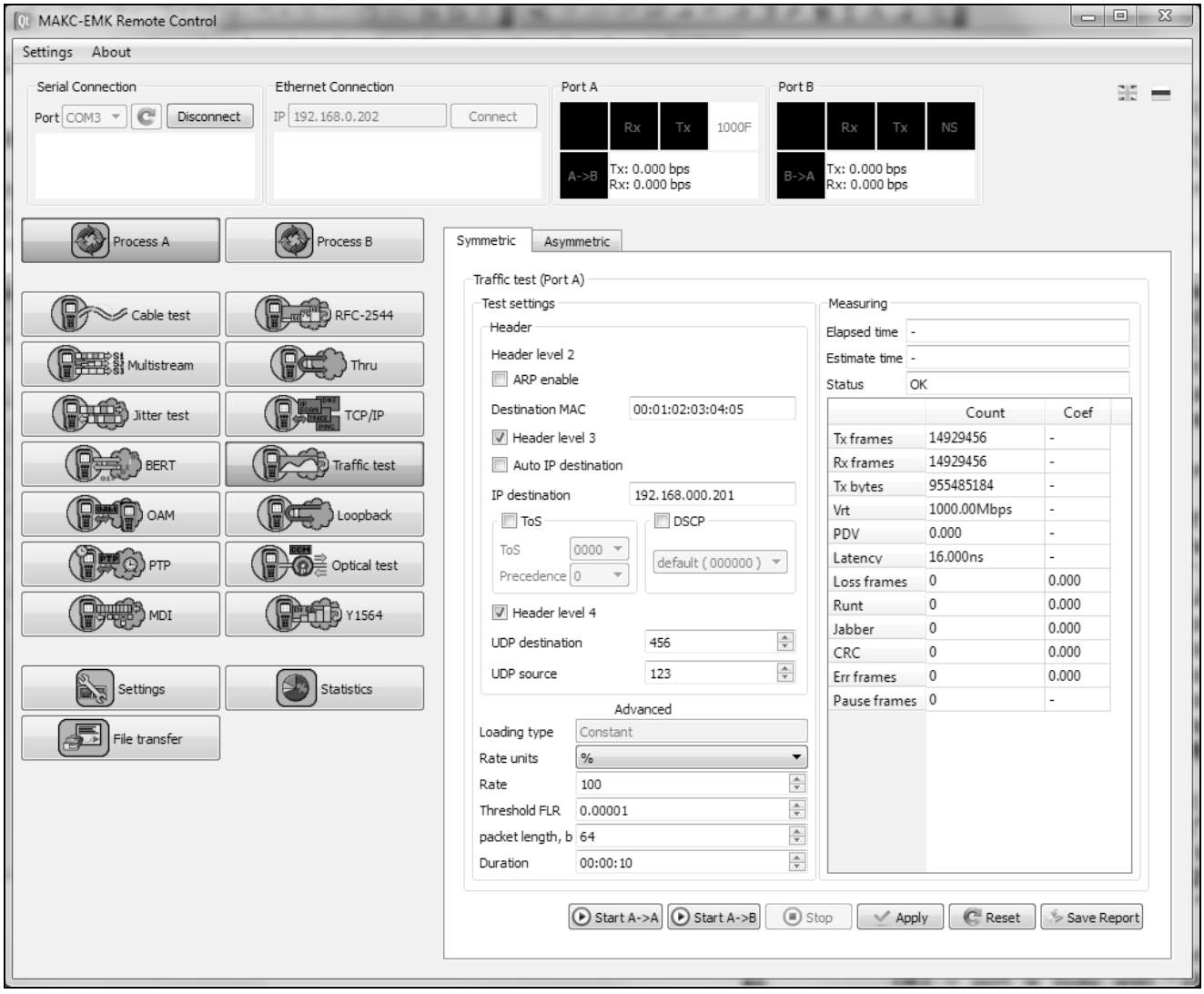

Figure 10.22 Remote Control Software

To manage the Tester via USB, select number of the virtual COM port connected to Tester interface in **“Port”** drop-out list and press **“Connect”** button.

To manage the Tester remotely via Ethernet, enter IP address of the third Ethernet interface into **“IP”** input field of **“Ethernet Connection”** section and press **“Connect”** button. Management of the Tester via Ethernet is analogous to its management via USB.

If connection is successful, the connected device info indicating its type will appear in the status bar. Also CPU and FPGA firmware versions values and Tester serial number will be displayed. Measurement functions tab will become active. Press **“Disconnect”** button if disconnection is required (for example, to upgrade the Tester software or connect another device).

Remote Management functionality is analogous to functionality of the Tester.

Measuring ports status is displayed in **“Port A”** and **“Port B”** upper status group. Status group messages update automatically one time per second. The group comprises four LEDs: **Test**, **Rx**, **Tx** and **Link** (from left to right). LEDs show different status information depending on Tester operation modes. Meaning and highlighting of indicator captions correspond to LEDs meaning and their captions (refer to Paragraph 4.1.1).

Test LEDs show port engagement in test fulfillment. Test LED captions may be as follows:

BERT – port is busy with **“BER”** test traffic reception or transmission;

CAB – port is busy with cable test signals transmission and reception;

DNS – port is busy with **“DNS”** test packets transmission and reception;

JIT – port is busy with **Packet Jitter** test traffic transmission or reception;

LB1 – Layer 1 **“Loopback”** mode is on;

LB2 – Layer 2 **“Loopback”** mode is on;

LB3 – Layer 3 **“Loopback”** mode is on;

LB4 – Layer 4 **“Loopback”** mode is on;

MDI – port is busy with **“MDI”** test traffic transmission;

MS – port is busy with **“Multistream”** test traffic transmission and reception;

OAM – OAM mode is activated;

PING – port is busy with **“Ping”** test traffic transmission and reception;

PTP – port is busy with **“PTP”** test data reception or transmission

RFC – port is busy with **“RFC 2544”** test traffic transmission or reception;

SCAN – port is busy with **“IP Scanner”** test traffic transmission or reception;

THRU – **“Thru”** menu has been selected or **“Thru”** mode is on;

TRT – port is busy with **“Traceroute”** test packets transmission and reception;

TRAF – port is busy with traffic test data transmission or reception;

Rx LED indicates data reception status. Green **Rx** LED reports that the port is busy with traffic reception.

Tx LED indicates data transmission process. Yellow highlighting of **Tx** LED reports that the port is busy with traffic transmission.

Link LED indicates connection status. **Link** LED captions indicate data transmission speed: **1000** for 1000BASE-T and 1000BASE-X, **100** for 100BASE-T, **10** for 10BASE-T, **NS** – no synchronization. **"H"** symbol stands for half duplex mode and **"F"** symbol stands for full duplex mode.

Data transmission and data reception speeds on interfaces are indicated below LEDs in bps. Parameter values can be defined as instantaneous values of reception and transmission information rates without notice of preamble, interframe gap and start frame delimiter.

"Process A" and **"Process B"** buttons select a port whose menu is being displayed on screen.

The list of tests and MAKS-EMK functions can be found on functional tabs on the left side panel. Functional tabs are as follows:

- **Cable Test**
- **RFC 2544 Test**
- **Multistream Test**
- **Thru**
- **Packet Jitter**
- **TCP/IP Test**
- **BER Test**
- **Traffic Test**
- **OAM**
- **Loopback Test**
- **PTP**
- **Optical Test**
- **MDI Test**
- **Settings**
- **Statistics**
- **File Transfer**

Settings of all tests and functions are analogous to the tests and functions presented by the on-screen menu (see the corresponding paragraphs 10.4 - 10.21).

To activate changed settings, press **"Apply"** button. If you need to return to the settings saved in Tester memory, press **"Reset"** button. Test results and statistics information are updated automatically once per second. Tests

are launched by **“Start”**, **“Start A->A»**, **“Start A->B”**, **“Start B->A”** and **“Start B->B”** buttons (dependent on possible and required test topologies).

10.22.4 Transfer of Report Files and Settings

Use **“File Transfer”** tab for generation of test reports on a PC and using Remote Control Software. To display all the files pre-saved in Tester memory, press **“Update”**.

Reports and test settings are divided into separate files.

Select the required report file and download it using **“Save pdf-report”** button. At that, the pdf-formatted report will be saved into PC memory. The new file will be shown in the list of saved files in remote control software.

To save the file with the required settings into remote control software, press **“Save”** button, enter file name in the pop-up window and press **“OK”**. The new file will be shown in the list of saved files in remote control software.
Files containing settings or reports that were saved before can be downloaded or deleted by means of **“Download”** and **“Delete”** buttons. The used should select the file to be downloaded or deleted first.

Screenshot*

To make a screenshot you should press **“Screenshot”** button in **“File Transfer”** tab. Save the file in *png format using the dialogue box that will pop out.

Note*: When the tester is managed remotely, **“Screenshot”** option is deactivated.

10.23 Tester Settings and Options

10.23.1 General Settings

“Common” tab of **“Device Settings”** menu is illustrated in Figure 10.23.

“Common” tab contains the following fields:

Language – interface language selection: Deutsch, English.

Sound – marking of this field activates test sounds. Audio signal sounds when information messages are displayed, if a test is unsuccessful or if battery is low.

Serial Number – serial number of the Tester.

Version – displays release number of the embedded software.

Reset to default settings – return of all menus to factory settings. Hover the cursor over the field to discover **“Reset”** button. Press the button.

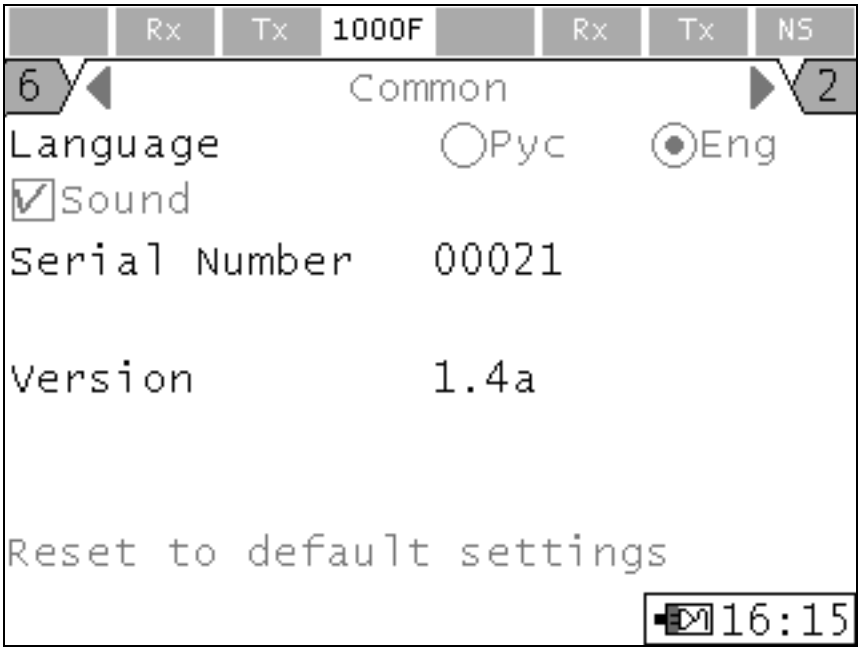

Рис. 10.23 Tester Settings

10.23.2 Options

Extra functions of MAKS-EMK Tester will be available after purchase of the corresponding options. To activate one or several options, the user should get activation key which is unique for each existing MAKS-EMK Tester.

Find **“Key”** field on the screen.

Key – enter the key into the required Tester field. If the key is shorter in characters than the field, set low bits of the digit. After entering the key, press **“Activ.”** button. **“Key”** field will display zero value after activation of the key.

Note: if activated options happened to reset as a result of misoperation or due to any other reasons, please contact the manufacturer’s support engineers.

If the activation was successful, Remote Management Software buttons and menu items responsible for the corresponding functions will become unblocked. Also, names of the activated options will be displayed under **“Key”** field. List of existent Tester options is presented in Table 10.23.

Table 10.23

Option Name	Description
08-RC	Remote Management via Ethernet
08-MPLS	Settings of MPLS packet fields
08-MS	Multistream Test
08-PTP	Time Synchronization PTP IEEE1588
08-Y1564	Y.1564 Measurement (SAM)
08-IPTV	MDI Metrics Measurement
08-AT	Asymmetric Channels Testing

10.23.3 Date and Time

The menu displays current date and time settings.
Date – current date setting and display.
Time – current time setting and display.

Press **“F4”** key to enter **“Date and Time”** tab of **“Device Settings”** menu from any menu of the Tester.

10.23.4 Battery

Voltage – the field displays value of battery voltage in V.

10.23.5 Display

The menu shows current settings of display brightness and contrast.
Brightness – image brightness settings;
Contrast – image contrast settings.

10.23.6 Checking

The menu displays checking modes of the Tester. Only one field of the below mentioned can be marked at a time.

Switch Off – marking disables switching of checking signals.
Clock frequency – marking enables switching of bit-timing frequency checking signals.
Velocities – marking enables switching of information speed and amount checking signals.
GPS checking – marking enables switching of the signal checking GPS synchronization error.
PPS discrepancy checking – marking enables switching of the signal checking synchronization discrepancy measurement error.

11 Checking Procedure

The present test procedure determines methods and instruments of primary checking and periodic re-checking of MAKS-EMK packet network Testers manufactured by JSC SPE “KOMETEH” registered in St. Petersburg, Russia. In-service Testers and Testers after being stored or/and repaired are subject to checking.

Re-checking period makes up 2 years.

11.1 Checking Stages

Tester maintenance reduces itself to periodic visual inspection of the power unit and the cords aimed at keeping them clean and in good order.

11.1.1 During checking, stages listed in Table 11.1 should be performed.

Table 11.1

No.	Operation Name	Test procedure paragraph	Conducting an operation at	
			primary checking	periodic re-checking
1	External examination	11.7.1	Yes	Yes
2	Assaying	11.7.2	Yes	Yes
3	Bit-timing frequency error calculation	11.7.3	Yes	Yes
4	Calculation of frequency error at payload transmission	11.7.4	Yes	No
5	Calculation of information content measurement error	11.7.5	Yes	Yes
6	Determination of GPS synchronization error	11.7.6	Yes	Yes
7	Determination of error in synchronization discrepancy measurement	11.7.7	Yes	Yes

11.2 Checking Instruments

11.2.1 When checking the Tester, you should use checking instruments listed in Table 11.2.

Table 11.2

Test procedure paragraph	Name of checking instrument, its type and metrological characteristics
11.7.3, 11.7.4, 11.7.5	Electronic frequency analyzer: 0.1 Hz – 1500 MHz, (0,03–10) V, $\pm 5 \cdot 10^{-7} f \pm 1$ units; ≥1 MOhm
11.7.6	Stanford Research Systems rubidium frequency standard, FS725 ±10 ns
11.7.7	Pendulum CNT90 counting-type electronic frequency analyzer with $\pm 2.5 \cdot 10^{-6}$ s impulse duration measurement function

11.2.2 It is acceptable to use other checking instruments with metrological characteristics analogous to those of the listed equipment.

11.2.3 Checking instruments must be in good order, they must be verified and have verification certificates.

11.3 Skill Requirements

Checking must be performed by certified personnel familiar with the present test procedure as well as user manuals of MAKS-EMK Tester and checking instruments.

11.4 Safety Requirements

You must implement safety measures specified in Tester and checking instruments' user manuals during checking process.

11.5 Checking Conditions

11.5.1 When checking the Tester, you should observe the following conditions:

- environment temperature (20±5)°C;
- relative air humidity (65±15)%;
- atmospheric pressure (100±8) kPa;
- supply voltage (220±11) V;
- industrial network frequency (50±0.5) Hz.

11.6 Preparation for Checking

11.6.1 Prior to checking the Tester, you should check operating instructions for availability and make sure that validity period of checking instrument certificate has not expired.

11.6.2 Switch checking instruments on and warm them up for as long as it is specified in their user manuals.

11.7 Checking

11.7.1 External Examination

Method of visual inspection is used to check conformance of the products to their technical documentation (as to completeness, proper marking and package). Also, Tester is checked for visible damage as well as connecting cables, clamps and connectors are checked for integrity.

11.7.2 Assaying

You should assay the Tester after you have studied its user manual. Ability of the Tester to switch on, its service capability as well battery status and Tester ability to operate from AC mains using adapter/power supply unit are to be checked.

Battery operation of the Tester should also be checked. If necessary, charge the battery using AC adapter coming with the Tester. Check Interface Settings selection, general settings, test procedure setting, cables and service capability in basic modes in the specified sequence.

11.7.2.1 Connect port A of the assayed MAKS-EMK Tester to its port B. Enter “Interface Settings” menu and configure measuring interfaces with the following manually preset parameters: port A IP address - 192.168.0.200, port B IP address - 192.168.0.201, port A MAC address – 00:50:C2:F9:C0:06, port B MAC address – 00:50:C2:F9:C0:07, VLAN – 0, interface bit rate for both measurement ports – 1000 Mbps. Select “Process B” menu – “Loopback” and set Layer 1. Then select “Process A” menu – “Terminal A>>A” – “RFC 2544” and configure RFC 2544 throughput test with default settings. Specify port B IP address as the destination IP address and mark “Automatic Destination MAC”. Disable other RFC 2544 tests. RFC 2544 test is enabled by pressing “Start” button. Test pass is observed at different packet lengths at physical Layer.

11.7.2.2 Connect port A of the assayed MAKS-EMK Tester to its port B. Select “Process B” menu – “Loopback” and set Layer 2. Then select “Process A” menu – “Terminal A>>A” – “RFC 2544” and enable throughput test from

RFC 2544 test package according to paragraph 11.7.2.1. Observe test pass at different packet sizes at data link Layer. Similarly, observe test pass at networking Layer after setting Layer 3 Loopback.

11.7.2.3 Connect port A of the assayed MAKS-EMK Tester to its port B. Select “Process B” menu – “Loopback” and set Layer 3. Then select “Process A” menu – “Terminal A>>A” – “Traffic Test” with the following settings: load 100%, packet length - 64 bytes, нагрузка 100%, test duration – 10 seconds. Start the test and observe it pass successfully. Transmission of the selected frames can be observed in “Statistics” menu. Test with 1518 bytes packet size is run in a similar manner.

11.7.2.4 It is necessary to control required parameters and statistics on Tester menu and their service capability in the corresponding modes.

11.7.3 Clock frequency error calculation

Bit-timing frequency error is calculated by means of a frequency analyzer.

Mark “**Clock frequency”** field of **“Checking”** tab (see Paragraph 10.21.7), **“Device Settings”** menu.

Frequency analyzer is connected to the slot of MAKS-EMK tester being checked by means of К08.1 cable. The measured value must be 125.00 MHz with a relative accuracy of $2 * 10^{-5}$.

11.7.4 Calculation of Frequency Error at Payload Transmission

100% channel load error is calculated by means of a frequency analyzer.

Frequency analyzer is connected to the slot of the tester being checked by means of К08.1 cable. Mark **“Velocities”** field of **Checking”** tab (see Paragraph 10.22.6), **“Device Settings”** menu.

Frequency of information bytes transmission during package generation with irreducible time slot for several packet lengths is measured. Absolute measurement error is ±15 kHz.

Absolute error is measured as follows:

$$\Delta = F_{BTF} - F_T, \text{ where}$$

F_{BTF} – bit-timing frequency measured by frequency analyzer;
F_T – theoretical value calculated for each data link speed.

Maximum channel load is calculated according to the following formula:

$$F_T = 125 \times M \times (L+8)/(L+20) \text{ MBps}, \quad \text{where}$$

L – packet length, bytes
M = 1 for 1000BASE-T
M = 0.1 for 100BASE-T
M = 0.01 for 10BASE-T

Depending on transmission speed and packet length, bit-timing frequency (F_{BTF}) values in MHz are listed in Table 11.3. Limits of tolerable bit-timing relative error (with account of temperature instability and aging treatment) make up ±15 kHz.

Table 11.3

Packet Length, bytes	10BASE-T	100BASE-T	1000BASE-T
64	1.071	10.714	107.143
512	1.222	12.218	122.180
1518	1.240	12.402	124.025

Deactivate all tests on port B of MAKS-EMK Tester by means of “Process B” menu. Make sure there are no captions under port B “Test” LED. Set connection speed of 10 Mbps for both measurement ports on “Interface Settings” menu. Activate “Traffic Test” with the following settings: load -100%, frame length – from Table 11.3, test duration – 10 seconds on “Process A” menu, “Terminal A>>B” topology. This test measures frequency value. Measurements for connection speeds of 100 and 1000 Mbps are performed in the similar manner for each frame length.

11.7.5 Calculation of Data Amount Error

Mark **“Velocities”** field of **Checking”** tab (see Paragraph 10.22.6) of the tester being checked, **“Device Settings”** menu.

Connect port A and port B of the tested MAKS-EMK by means of a patch cord. Deactivate all tests on port B via “Process B” menu and make sure there are no captions under “Test” LED of port B. Mark “Auto clear.” on “Statistics” menu on “Common” tab. Specify connection speed of 10 Mbps for both measurement ports on “Interface Settings” menu. Activate “Traffic Test” with the following settings: load – 100 %, packet length – 64 bytes, test duration – 1 second and manually set MAC addresses on “Process A” menu, “Terminal A>>B” process topology. Activate “Traffic Test” with the following settings on “Process A” menu, “Terminal A>>B”. Make sure the test has been successful (“Statistics” menu). Record N_M , i.e. number of measured bytes received on Port B (“Common” Tab – Port B – Rx bytes). Concurrent with test launch, perform measurements by means of frequency analyzer connected to DUT.

Connect a frequency analyzer to the ⊖→slot of MAKS-EMK tester being checked by means of К08.1 cable. Measure received bytes number (Nf) with regard to packet preamble that will be determined by the number of measured impulses.

Measurements for 1518-byte packet length are performed in analogous way.

Calculate absolute error by the following formula:

$$\Delta = Nf*L/(L+8) - N_м, \quad \text{where}$$

Nf – information content in bytes measured with frequency analyzer with consideration of packet preamble.

Nм – information content in bytes measured without consideration of packet preamble .

L – frame length in bytes.

Absolute measurement error is equal to ±1 byte.

11.7.6 Determination of GPS Synchronization Error

Only MAKS-EMK tester of “E” modification with a GPS antenna jack is subject to checking.

Mark **“GPS Checking”** field on **“Checking”** tab of **“Device Settings”** menu (please refer to par. 10.22.6).

GPS synchronization error is calculated by means of a phase differential analyzer.

The phase differential analyzer is connected to the Tester according to the diagram shown in Figure 11.7.1. Connect the GPS/GLONASS antenna to the GPS jack of MAKS-EMK Tester. 1 Hz reference signal is supplied to slot 1 of the phase differential analyzer. Connect ⊖→ slot of the MAKS-EMK Tester being checked to slot 2 of the phase differential analyzer by means of К08.1 cable.

Make the needed measurements using the phase differential analyzer simultaneously with performing the test.

Phase differential analyzer measures ΔT_{ph} and MAKS-EMK Tester measures $\Delta T_м$.

Calculate absolute error by the following formula:

$$\Delta = \Delta T_{ph} - \Delta T_м \ , \quad \text{where}$$

ΔT_{ph} – synchronization phase differential measured by means of the phase differential analyzer;

ΔT_M – synchronization phase differential measured by means of MAKS-EMK Tester.

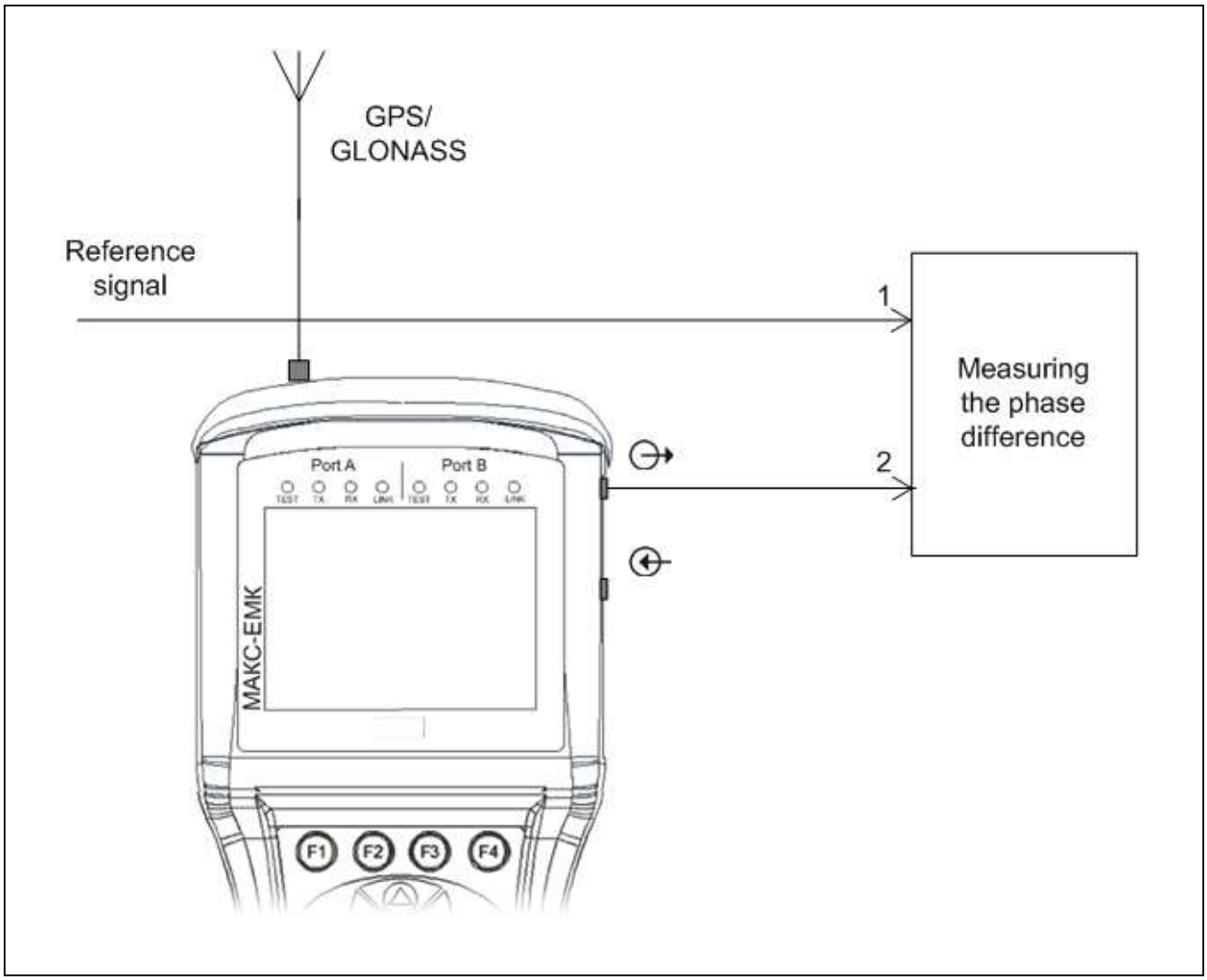

Figure 11.7.1 Diagram of GPS Synchronization Error Measurement

Synchronization phase differential is a value of the time slot between the edge of reference synchronization signal and the edge of GPS synchronization signal.

Absolute measurement error is equal to 1 ms.

11.7.7 Determination of Error in Synchronization Discrepancy Measurement

Only MAKS-EMK tester of “E” modification is subject to checking.

Mark **“PPS discrepancy checking”** field on **“Checking”** tab of **“Device Settings”** menu (please refer to par. 10.22.6).

Error in synchronization discrepancy measurement is determined using an impulse duration analyzer.

The 1 Hz reference source is connected to ⊖slot of MAKS-EMK Tester by means of K08.1 cable according to the diagram shown in Figure 11.7.2. and then connect ⊖slot of the Tester to the impulse duration analyzer. A rubidium time and frequency standard serves as a reference source.

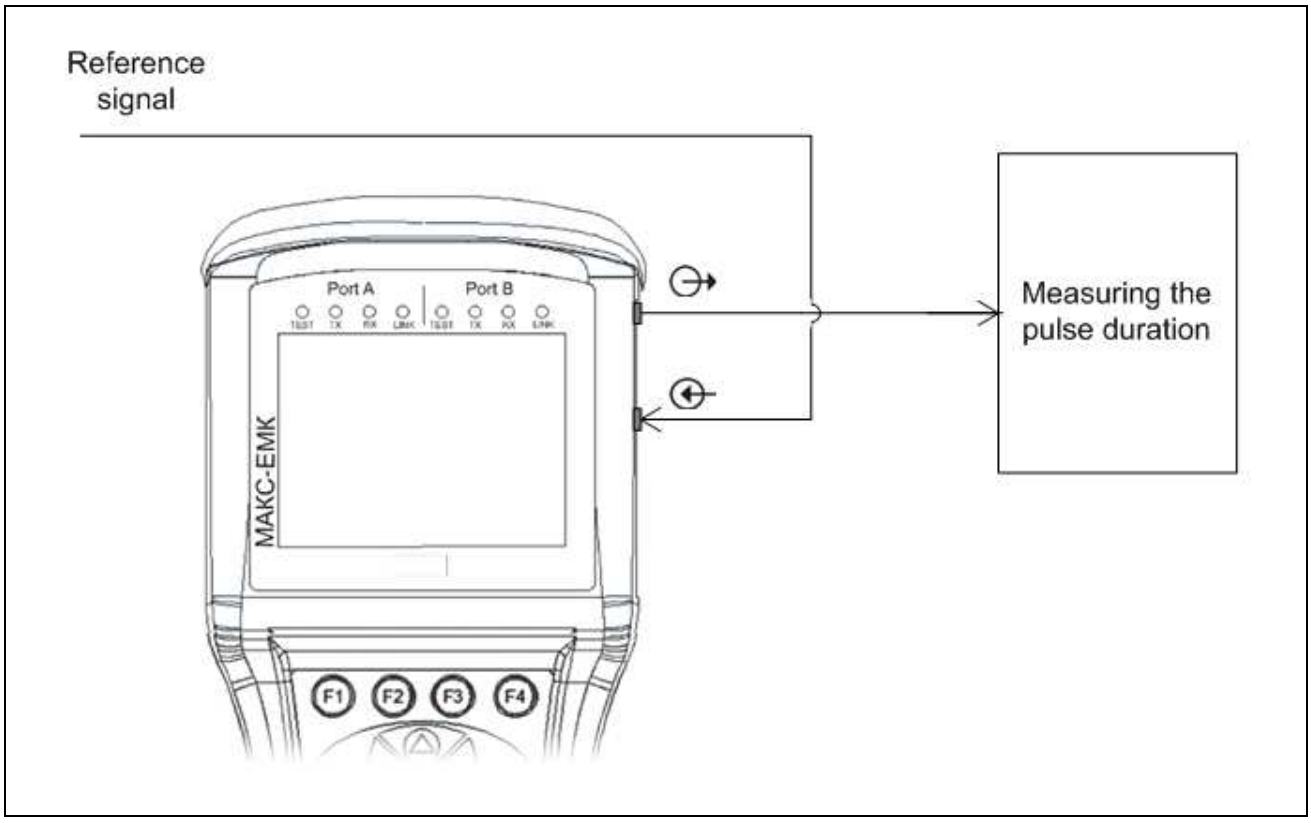

Figure 11.7.2 Diagram of Error Determination in Synchronization Discrepancy Measurement

Make the needed measurements using the impulse duration analyzer simultaneously with launching the test.

Impulse duration analyzer measures Δ_{ph} and MAKS-EMK Tester measures Δ_{M}.

Calculate absolute error by the following formula:

$$\Delta = \Delta_{ph} - \Delta_{м} \ , \quad \text{where}$$

Δ_{ph} – impulse duration measured by means of the impulse duration analyzer;

$\Delta_{м}$ – impulse duration measured by means of MAKS-EMK Tester.

Absolute measurement error is equal to 10 ns.

11.8 Checking Result Presentation

11.8.1 Checking results are registered in a log and, if Tester corresponds to the requirements stated in technical documentation, a set form certificate is issued.

11.8.2 If checking fails, the Tester will be supplied with a document stating it is unusable and giving reasons for its rejection.

12 Maintenance

12.1 Maintenance of the Tester comes down to periodic visual inspection of its power unit and cables and is aimed at keeping them clean and operable.

13 Transportation and Storage

13.1. Tester packed in its standard container can be transported by road, in house railroad cars, in leak-proof aircraft and ship holds at air temperature of - 25 °C…+ 55 °C and relative air humidity of 95 %. Please observe shipping and load fastening rules during transportation on the corresponding mode of transport.

13.2. It is possible to transport the Tester by road:

- class I roads: to distances up to 1,000 km at a speed of 60 kmh max.
- class II to III roads and earth roads: to distances up to 250 km at a speed of 40 kmh.

13.3. Please observe handling instructions and warning label information when handling, loading and unloading.

13.4. Tester packed in its standard container should be stored in heated warehouse rooms at air temperature of 0 °C…+ 40 °C and at relative air humidity of 80 % at temperature of + 35 °C. Storage time should not exceed 6 months.

13.5. Warehouse rooms where Tester is stored must be free from acid and alkali fumes as well as other aggressive agents that may cause metal corrosion.

13.6. Please observe general regulations of fire safety when transporting and storing the Tester.

14 Product Details

Name: Packet Network Tester and Analyzer MAKS-EMK

Designation: МБСЕ. 468212.008

Release date:

State Register Identification Number	
Certification Data	

Manufacturer: CJSC SPE “KOMETEH”

P.O.Box 140, Saint Petersburg, 190103, Russia

Ph.: +7 (812) 333-06-61
Ph./Fax: +7 (812) 333-08-09
e-mail: mail@kometeh.ru
www.kometeh.ru

Manufacturer’s Warranty

Manufacturer warrants compliance of MAKS-EM MBCE. 468212.008 TS Tester to specification requirements on the understanding that transportation, storage and operating rules are observed by customer. Warranty period is equal to 24 months from the date the customer took delivery of the Tester.

The stated period may be changed by mutual agreement of the parties in the delivery contract.

Acceptance Certificate

MAKS-EMK Tester MBCE. 468212.008 TS with serial number _____ was manufactured and accepted in accordance with state standards exclusive requirements and operative technical documentation and it is recognized ready-for-service.

Chief Quality Inspector

_____ personal signature

_____ print full name

_____ _____ _____
dd mm yyyy

Chief Engineer

_____ personal signature

_____ print full name

Stamp here

_____ _____ _____
dd mm yyyy

Packing Certificate

MAKS-EMK Tester, serial number _____ was packed according to the requirements stipulated by the operative technical documentation.

function of undersigned	personal signature	print full name

_____ _____ _____

dd mm yyyy

Information on Primary Checking and Periodic Re-Checking

Table

Checking Date	Type Of Checking	Checking Results	Function of undersigned	Signature

Reclamation

Checking Date	Type Of Checking	Checking Results	Function of undersigned	Signature

Companies or institutions operating the Tester claim reclamation for the equipment according to the established rules.

Reclamation data should be tabulated (see the table below):

Table

Defect detection date	Operation time before defect detection	Defect cause	To whom and when reclamation was delivered	Date of receipt or commissioning of the Tester after reclamation

Appendix A.

Table A.1. ToS Byte Bit Name

P2	P1	P0	T3	T2	T1	T0	CU0

Table A.2. Precedence Field Value

Precedence	Name
0	Routine
1	Precedence
2	Immediate
3	Flash
4	Flash Override
5	CRITIC/ECP
6	Internet Work Control
7	Network Control

Table A.3. DSCP-byte Bit Names

DS5	DS4	DS3	DS2	DS1	DS0	ECN	ECN

Table A.4. Values of DSCP Field

Name	DSCP Binary Value	DSCP Decimal Value
AF11	001010	10
AF12	001100	12
AF13	001110	14
AF21	010010	18
AF22	010100	20
AF23	010110	22
AF31	011010	26
AF32	011100	28
AF33	011110	30
AF41	100010	34
AF42	100100	36
AF43	100110	38
CS1	001000	8
CS2	010000	16
CS3	011000	24
CS4	100000	32
CS5	101000	40
CS6	110000	48
CS7	111000	56
Default	000000	0
EF	101110	46

Table A.5. Frame Loss Possibility According to AF Classification for DSCP Field

Frame Loss Probability	Category 1	Category 2	Category 3	Category 4
low	AF11	AF21	AF31	AF41
medium	AF12	AF22	AF32	AF42
high	AF13	AF23	AF33	AF43

Table A.6. Throughput re-calculation as to Layer 2, T_{L2} of a pure channel for different frame length

	Connection Speed V_f , Mbps		
Frame Length	10	100	1000
64	7,6190	76,190	761,90
128	8,6486	86,486	864,86
256	9,2754	92,754	927,54
512	9,6241	96,241	962,41
1024	9,8084	98,084	980,84
1280	9,8462	98,462	984,62
1518	9,8700	98,700	987,00

Table A.7. Conformance of MDI and MDI-X signals to contacts

Contact	MDI	MDI-X
1	BI_DA+	BI_DB+
2	BI_DA-	BI_DB-
3	BI_DB+	BI_DA+
4	BI_DC+	BI_DD+
5	BI_DC-	BI_DD-
6	BI_DB-	BI_DA-
7	BI_DD+	BI_DC+
8	BI_DD-	BI_DC-

Table A.8. Time Source Enumeration

Value*	Time Source	Description
10	ATOMIC_CLOCK	Any device, or device directly connected to such a device, that is based on atomic resonance for frequency and that has been checking against international standards for frequency and, if the PTP timescale is used, time
20	GPS	Any device synchronized to a satellite system that distribute time and frequency tied to international standards
30	TERRESTRIAL_RADIO	Any device synchronized via any of the radio distribution systems that distribute time and frequency tied to international standards
40	PTP	Any device synchronized to a PTP-based source of time external to the domain
50	NTP	Any device synchronized via NTP or Simple Network Time Protocol (SNTP) to servers that distribute time and frequency tied to international standards
60	HAND_SET	Used for any device whose time has been set by means of a human interface based on observation of an international standards source of time to within the claimed clock accuracy
90	OTHER	Other source of time and/or frequency not covered by other values
A0	INTERNAL_OSCILLATOR	Any device whose frequency is not based on atomic resonance nor checked against international standards for frequency, and whose time is based on a free-running oscillator with epoch determined in an arbitrary or unknown manner
F0-FE	For use by alternate PTP profiles	
FF	Reserved	
* All other values in Table 8 are reserved.		